



**US Army Corps
of Engineers.**

**Sacramento District
Engineering Division**

Sutter Basin Pilot Feasibility Report - Environmental Impact Report / Supplemental Environmental Impacts Statement

Butte and Sutter Counties, California

COST ENGINEERING APPENDIX

Oct 2013

TABLE OF CONTENTS	PAGE
1. Basis of Estimate.....	3
Cost Estimate for Draft Alternative Array	
Feasibility Cost Estimates for Final Alternative Array	
2. Project Scope/Description.....	3
3. MII Cost Estimate – Notes and Assumptions.....	4
4. Contractor Markups.....	7
5. Construction Schedule.....	8
6. Cost and Schedule Risk Analysis.....	8
7. Total Project Costs.....	9

1. BASIS OF ESTIMATE

COST ESTIMATE FOR DRAFT ALTERNATIVE ARRAY

Cost estimates were developed to compare the draft array of alternatives presented in the Feasibility Study Report. These cost estimates were utilized to select the final array of alternatives and were based on a level 4 per requirement of ER 110-2-1302. In developing the reconnaissance level cost estimates of the various measures and alternatives (combined measures) for the Sutter Basin project, the Cost Engineering team utilized a methodology wherein costs for levee improvements or new levees (sans relocations) were developed using a parametric spreadsheet based on typical cross sections for differing types of levee improvements. Costs for relocations and construction other than that directly related to the levee were compiled based on either 1) historical costs - past levee projects in the vicinity of Sacramento, 2) estimating software MII (MCACES, 2nd Generation) or PACES, or 3) based on a percentage of construction costs. In lieu of the time constraints of the 24-month fast-track pilot study schedule, these methods were used for preparing costs for the purpose of selecting the final array of alternatives. Refer to Attachment A for further detail on the background and approach to developing cost estimates for the draft array of alternatives.

FEASIBILITY COST ESTIMATES FOR FINAL ALTERNATIVE ARRAY

The baseline feasibility cost estimates for the final array of alternatives (SB-1, SB-7 & SB-8) were developed using the design drawings provided by Civil Design. The quantities take-off calculations were provided by the Sacramento District's Civil Design section to produce the feasibility estimates. There are 41 Reaches spanning approximately 40 miles of levee. The breakdown of the alternatives by reach is further described in paragraph 2. Most of the geotechnical levee repair for the alternatives is to be accomplished with a soil-bentonite slurry wall constructed in the centerline of the levee. There are locations where jet grout, seepage berm or relief wells are also utilized but they are small in magnitude relative to the SB slurry wall. Of the 41 Reaches, there are several Reaches where no levee work is proposed (Reach 14, 15, 29, and 39).

Due to the large scope, the project is broken into construction contracts. To facilitate comparison to the local sponsor Early Implementation Project (EIP), similar contract reaches were utilized. These contracts have no impact on the total project cost. Based on the anticipated yearly funding availability, the reaches were combined in more manageable contracts, totaling approximately \$40 million per contract per year for the feasibility study. Refer to tables in paragraph 5 for breakdown of contracts by reach.

2. PROJECT SCOPE/DESCRIPTION

There are three final Alternatives (SB-1, SB-7 & SB-8) to be evaluated for selection of the Recommended Plan. Alternative SB-1 is the No Action plan, which is to do nothing; hence a cost estimate was not created. It is assumed that Alternative SB-1 has no federal cost.

Alternative SB-7 is to Fix-in-Place the Feather River West Levee from the Sunset Weir to Laurel Avenue. The Alternative SB-7 project footprint extends from FRWL Reach 2 through 21. Alternative SB-8 is to Fix-in-Place the Feather River West Levee from Thermalito Afterbay to Laurel Avenue. The SB-8 project footprint extends from FRWL Reach 2 through 41. Alternative SB-8 is an incremental addition to Alternative SB-7 and all elements in Alternative SB-7 exist in Alternative SB-8.

Alternative SB-8 is almost equivalent to the Feather River West Levee Project (FRWLP) with the exception of Reach 6. At Reach 6, the Sponsor has constructed the Star Bend Setback Levee. However, during plan formulation the PDT proposed to have Reach 6 as a Fix-In-Place levee in lieu of Setback Levee because it is more cost effective. The Sponsor is seeking credit for work at this location. An estimate for the Star Bend Setback levee was created for cost comparison.

The designs for Alternatives SB-7 and SB-8 are similar in terms of levee remedial methods needed to reduce flood risk to the Sutter Basin. The vast majority of levee remediation is to reduce seepage by constructing a soil-bentonite slurry cutoff wall through the centerline of the levee and rebuild the levee to pre-project geometry. At some locations, seepage berms, relief wells, deep-soil-mixing, jet grout cutoff walls, canal relocations, and slight levee relocations to provide O&M access roads are included but they are minor relative to the soil-bentonite cutoff wall construction. Detail of the design remedial methods can be found in the Civil Design Appendix.

Along the FRWL, there are abandoned utilities that need to be removed. Active utilities such as pressure pipes, irrigation pipes, drainage pipes, electrical, sewer, gas, cable and water lines are to be removed and replaced in order to construct the soil-bentonite cutoff wall. Temporary utilities service is to be provided during the service outages. Roads on the levee crowns that must be removed in order to demolish or relocate utilities will be replaced.

3. MII COST ESTIMATE – NOTES & ASSUMPTIONS

The MII estimate used the QTO's provided by Civil Design. An estimate on the construction contracts and years for Alternatives SB-7 and SB-8 is presented below in paragraph 5.

MCACES PROGRAM & LIBRARIES

The program and libraries used for the MCACES cost estimate are as follows:

- a. MII version 4.1 Build 4
- b. 2010 Cost Book
- c. 2011 EP1110-1-8 Equipment Library for Region VII.

OVERTIME

Overtime is included in the estimate. Assumption is 10 hour workdays, 6 days per week.

ACQUISITION PLAN

Construction contracts are assumed to be Invitation For Bid (IFB), Competitive, Unrestricted Full and Open Competition and all businesses may respond.

CONTRACTING PLAN

The prime contractor is expected to be an earthwork contractor responsible for site work, borrow site excavation, levee degradation, slurry wall construction, and levee embankment reconstruction. The utilities penetration relocation is expected to be done by a specialty subcontractor. Material hauling, hydroseeding, jet grouting, asphalt pavement, and other miscellaneous work are expected to be performed by subcontractors.

SITE ACCESS

The project footprint follows the existing levee along the west bank of the Feather River, northernmost from Thermalito Afterbay and extending southernmost to near the Sutter Bypass and Feather River confluence. The levee is assumed to be maintained by local Reclamation Districts (RD) and it is expected that the levee is accessible from the landside. Staging areas or stockpile areas are constructed every 2,500 lineal feet along or near the levee landside /waterside toes. Stripped topsoil material, aggregate base, and levee degrade material can be readily stockpiled in the staging areas. Haul routes for import/export material is expected to be on existing roads and highways (no barge transport). No new roadway for site access is expected to be constructed.

BORROW/DISPOSAL AREAS

Borrow sources identified by the sponsor are incorporated into the estimate. A material balance calculation was performed by SPK's Civil Design and Cost Engineering sections using sponsor QTO's for levee fill materials (Types 1, 2 & Random) available at each borrow site. It was concluded that there is enough material to satisfy the fill demand for Alternatives SB7 and SB8. The suitability of the borrow source/material has been evaluated by the SPK Geotech Section (please refer to Geotechnical Engineering Appendix for detail). Non-hazardous unsuitable fill material is assumed to be used to backfill the borrow pits. Other construction waste is assumed to be disposed of off-site in accordance with local, state, and federal regulations. HTRW waste is assumed to be absent from the project. Construction waste can be safely disposed of within a 30 mile radius of the site.

CONSTRUCTION METHODOLOGY

The construction methodologies for the soil-bentonite slurry wall excavation and placement are considered to be standard, except for deep walls (greater than 85 feet). Below this depth a conventional long reach hydraulic excavator cannot be used. The method provided in the cost estimate opts for the contractor to utilize a deep-soil-mixing (DSM) method for a design depth of cutoff wall greater than 85 feet.

CONSTRUCTION WORK WINDOWS

Due to environmental and wildlife concerns (wildlife habitat, migratory season, mating season etc.) it is assumed that a normal construction season would typically span from the month of May through October. Typically, USACE and local flood agencies want the levee to be

reconstructed by October due to the beginning of the storm season. This is a flood safety measure. Depending on local jurisdiction and permitting weather, construction tasks such as hydroseeding, asphalt pavement repair of levee crown, and associated work that does not undermine the structural integrity of the levee during a storm event may be permissible beyond October. The irrigation canal that runs parallel to the levee landside toe is operational from April through February. The construction window for work in the canal is limited from February through April. One approach for working around this limitation is to obtain an encroachment permit for a variance to work outside the normal construction season prior to working in the canal. Another approach is to install sheet pile cutoff walls to insure that the work within the levee does not lead to excessive seepage or possible failure of the canal bank. This second approach does not require a variance. For the purposes of the feasibility report, the estimate assumes installation of a sheet pile cutoff wall. Depending on the scope of work and pipe crossing type, each approach is site specific and will be more closely dealt with on a case by case basis in the PED phase.

UNIQUE TECHNIQUES OF CONSTRUCTION

In close proximity to existing bridge abutments, underground utilities, or railroad tracks, a jet grout cutoff wall is to be constructed in lieu of the slurry cutoff wall.

EQUIPMENT AND LABOR AVAILABILITY AND DISTANCE TRAVELED

The project is in Yuba City, an urban city environment and equipment & labor is readily available within a 100 mile radius of the site. No labor shortage is anticipated.

ENVIRONMENTAL CONCERNS

Environmental protection requires consideration of air, water, and land, and involves noise management, solid-waste management and management of other pollutants. In order to prevent or provide for abatement and control of any environmental pollution arising from construction, the Prime Contractor and Subcontractors in the performance of the contract shall comply with all applicable Federal, State, and local laws, as well as regulations concerning environmental pollution control and abatement. The Contractor shall use best management practices at all times to minimize the potential for environmental impacts.

LABOR RATES

This estimate meets the Davis Bacon wage rates for Davis Bacon Wage Determination for the State of California, General Decision Number: CA130009 04/05/2013 CA9 .

EQUIPMENT RATES

Equipment rates were obtained from quotes or verbal/telephone conversations and the MII 2011 EP1110-1-8 Equipment Library for Region VII.

MATERIAL COST

Material prices are obtained from vendor quotes, supply catalogs, previous estimates and the MII Cost Book.

SALES TAX

California State Sales tax is applied at 8.00%.

OMRR&R

The proposed project reaches of Alternatives SB-7 and SB-8 are currently maintained as part of the Federal Sacramento River Flood Control Project. The OMRR&R for the proposed project would be similar as the existing project. Therefore, no OMRR&R cost are included in the estimate. A qualitative analysis of the OMRR&R costs was performed to validate this assumption. Both alternatives are comprised almost entirely of installation of a soil-bentonite cutoff wall within the structural section of the levee. The levee will be reconstructed to existing pre-project geometry and meet USACE standards. The slurry wall will reduce the short term maintenance cost due to a reduction in seepage. The reconstruction of the upper half of the levee (side slopes, vegetation removal, grass re-establishment, and crown road replacement) will also reduce the short term maintenance cost. With the installation of the slurry wall, many of the existing relief wells can be decommissioned or converted to other functions and this would reduce short term maintenance costs. The Levee Safety requirements for typical levee cross-sections (side slopes, crown and O&M road widths, etc.) will somewhat increase the current maintenance costs due to a larger footprint of vegetation management. The replacement of utility and drainage pipe crossings would reduce maintenance costs in the short term. Overall, the short term OMRR&R will decrease. However, in long term the OMRR&R cost is about the same because the commitments remain unchanged.

LIFE CYCLE COST

A life cycle cost estimate was not performed for the study.

4. CONTRACTOR MARKUPS

Prime Contractor's Markups – Below is the breakdown of the Prime CTR markups.

Prime Contractor	Own Work	Sub Work
JOOH	10.00%	10.00%
HOOH	10.00%	10.00%
Profit	9.00%	5.00%
Bond	1.50%	1.50%

Subcontractors' Markups – Below is the breakdown of the general subcontractors' markups.

Piping/Relocation	Own Work
JOOH	8.00%
HOOH	10.00%
Profit	8.00%

Jet Grout	Own Work
JOOH	10.00%
HOOH	11.00%
Profit	8.00%

Paving	Own Work
HOOH	8.00%
Profit	8.00%

The contractor markups presented in the tables above are representative of past civil works estimates performed in the Sacramento region. Depending on the bidding environment and

availability of work in the region, the contractor markups can be higher or lower but the markups are expected be near those shown above. It is assumed that the subcontractors will perform all of their own work and will not subcontract any portion of it.

In addition to the contractor markups, a direct cost markup for Small Tools is estimated at 1.50% of Labor costs.

5. CONSTRUCTION SCHEDULE (SEE ATTACHED)

Alternative SB-7 is expected to consist of five (5) construction contracts. Alternative SB-8 would consist of seven (7) construction contracts. With the exception of the Star Bend FIP contract, each contract is assumed to be completed in two construction season. Star Bend FIP is a relatively small contract and it is assumed it can be constructed concurrently in the same year with another contract. If funding permits, multiple contracts can be awarded in the same year. An approximation on the construction contracts and year(s) of construction is presented below. The schedule assumes the project gets authorized and appropriated through the construction window. This projection assumes that there is no funding shortage to implement the contract(s) in a given year. Other considerations in drafting the construction schedule includes public safety, availability of qualified contractors and special construction equipment, construction windows, funding constraints and acquisition of real estate.

SB-7			
CONTRACT		FRWLP Reaches	Year for Construction
A		2-5	2020-2021
STAR BEND FIP		6	2019-2020
B		7-12	2019-2020
C	C1	13-18	2017-2018
	C2	19-21	2018-2019

SB-8			
CONTRACT		FRWLP Reaches	Year for Construction
A		2-5	2022-2023
STAR BEND FIP		6	2021-2022
B		7-12	2021-2022
C	C1	13-18	2017-2018
	C2	19-25	2018-2019
D	D1	26-33	2019-2020
	D2	34-41	2020-2021

6. COST AND SCHEDULE RISK ANALYSIS (SEE ATTACHED)

The scope of the risk analysis was to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110- 2-1302, Civil Works Cost Engineering, and Engineer Technical Letter

1110-2- 573, Construction Cost Estimating Guide for Civil Works. The contingency derived from the CSRA for Alternatives SB-7 and SB-8 is approximately 35% and 36% respectively.

7. TOTAL PROJECT COSTS (SEE ATTACHED)

REAL ESTATE (01 and 02 Accounts)

The Real Estate cost estimate (01 Account Lands & Damages and Administrative costs) is performed by the SPK Real Estate Division and provided to the Cost Engineering section. The 01 Account Lands and Damages, Relocation Assistance Payment, and New Utility Easements cost estimates were appraised to include 50% incremental costs (please refer to the Real Estate Appendix for more detail). These technical Real Estate increments estimated by the appraiser are independent of the contingency derived through the Cost and Schedule Risk Analysis (CSRA). The contingency for the Federal and Non-Federal Real Estate Administrative costs is estimated at 5% was provided by the Real Estate Division. The CSRA identified no additional contingencies for the 01 Account. The overall contingency for the 01 Account is 33% and 28% for Alternative SB-7 and Alternative SB-8 respectively. For the 02 Account Relocations, the Real Estate Division assessed no contingencies. The CSRA evaluated the relocations and have applied contingencies of 35% and 36% for SB-7 and SB-8 respectively.

ENVIRONMENTAL MITIGATION (06 Account)

The Environmental Mitigation cost estimate is performed by SPK Environmental Planning and provided to Cost Engineering. It is understood that Environmental Planning included its own contingencies (20%) in the Environmental Mitigation estimate due to their experience and field of expertise. Environmental Mitigation includes costs for Riparian Forest, Oak Woodlands, Elderberry, Giant Garter Snake, Wetlands, Air Quality, and ETL Compliance (please refer to the Environmental Planning Appendix for more detail). Environmental Planning also provided costs for tree removal. Since this is a construction cost the contingency applied to this task will be that derived from the Cost and Schedule Risk Analysis.

CULTURAL RESOURCES PRESERVATION (18 Account)











The Cultural Resources Preservation costs estimate was developed by SPK Archeologist and provided to Cost Engineering. The contingency applied to this account will be that derived from the Cost and Schedule Risk Analysis.

PLANNING, ENGINEERING AND DESIGN (30 Account)

The cost for Planning, Engineering and Design (PED) was provided by the project manager.

CONSTRUCTION MANAGEMENT (31 Account)

The cost for Construction Management (CM) was provided by construction.

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	January 21		March 11		May 1		June 21			
								1/1	1/22	2/12	3/5	3/26	4/16	5/7	5/28	6/18	7/9
1		Sutter Basin SB-7	1445 days?	Fri 2/3/17	Wed 9/15/21												
2		Contract C (13-21)	802 days?	Fri 2/3/17	Tue 8/27/19												
3		Contract C1 (13-18)	539 days?	Fri 2/3/17	Wed 10/24/18												
4		Contract Award	1 day	Fri 2/3/17	Fri 2/3/17												
5		NTP	1 day	Sat 2/4/17	Sat 2/4/17	4											
6		Construction Year 1	279 days?	Mon 2/6/17	Wed 12/27/17												
7		Mob, Demob & Preparatory Work	46 days	Mon 2/6/17	Thu 3/30/17												
8		Submittals	30 days	Mon 2/6/17	Sat 3/11/17	5											
9		Mobilization	6 days	Mon 3/13/17	Sat 3/18/17	8											
10		Staging Areas Setup	10 days	Mon 3/20/17	Thu 3/30/17	9											
11		Levees & Floodwalls Reach 13 - 18:	279 days?	Mon 2/6/17	Wed 12/27/17												
12		Top Soil Stripping	4 days	Fri 3/31/17	Tue 4/4/17	7											
13		Clearing & Grubbing	4 days	Wed 4/5/17	Sat 4/8/17	12											
14		Remove AB Surfacing	4 days	Mon 2/6/17	Thu 2/9/17	7SS											
15		Degrade Existing Levees	42 days	Mon 4/10/17	Sat 5/27/17	13											
16		SB Cutoff Wall Conventional	24 days	Fri 4/21/17	Thu 5/18/17	15SS+10 days											
17		SB Cutoff Wall DSM	87 days	Fri 5/19/17	Mon 8/28/17	16											
18		Jet Grouting	18 days	Tue 8/29/17	Mon 9/18/17	17											
19		Levee Embankment Fill	76 days	Sat 9/30/17	Wed 12/27/17	18SS+28 days											
20		Top Soil Replacment	4 days	Sat 12/23/17	Wed 12/27/17	19FF											
21		AB Surfacing Levee Crown	1 day	Wed 12/27/17	Wed 12/27/17	19FF											
22		Relief Well Conveyance Ditch	1 day?	Wed 12/27/17	Wed 12/27/17	19FF											
23		Construction Year 2	191 days	Fri 3/16/18	Wed 10/24/18												
24		Mob, Demob & Preparatory Work	16 days	Fri 3/16/18	Tue 4/3/18												
25		Mobilization	6 days	Fri 3/16/18	Thu 3/22/18												
26		Staging Areas Setup	10 days	Fri 3/23/18	Tue 4/3/18	25											
27		Levees & Floodwalls Reach 13 - 18:	191 days	Fri 3/16/18	Wed 10/24/18												
28		Top Soil Stripping	4 days	Wed 4/4/18	Sat 4/7/18	24											
29		Clearing & Grubbing	4 days	Mon 4/9/18	Thu 4/12/18	28											
30		Remove AB Surfacing	4 days	Fri 3/16/18	Tue 3/20/18	24SS											
31		Degrade Existing Levees	42 days	Fri 4/13/18	Thu 5/31/18	29											
32		SB Cutoff Wall Conventional	24 days	Wed 4/25/18	Tue 5/22/18	31SS+10 days											
33		SB Cutoff Wall DSM	87 days	Wed 5/23/18	Fri 8/31/18	32											
34		Jet Grouting	18 days	Sat 9/1/18	Fri 9/21/18	33											
35		Levee Embankment Fill	76 days	Sat 7/28/18	Wed 10/24/18	34FF+28 days											
36		Top Soil Replacment	4 days	Sat 10/20/18	Wed 10/24/18	35FF											
37		AB Surfacing Levee Crown	1 day	Wed 10/24/18	Wed 10/24/18	36FF											
38		Contract C2 (19-21)	490 days	Fri 2/2/18	Tue 8/27/19												
39		Contract Award	1 day	Fri 2/2/18	Fri 2/2/18												
40		NTP	1 day	Sat 2/3/18	Sat 2/3/18	39											
41		Construction Year 1	155 days	Mon 2/5/18	Fri 8/3/18												
42		Mob, Demob & Preparatory Work	46 days	Mon 2/5/18	Thu 3/29/18												
43		Submittals	30 days	Mon 2/5/18	Sat 3/10/18	40											
44		Mobilization	6 days	Mon 3/12/18	Sat 3/17/18	43											
45		Staging Areas Setup	10 days	Mon 3/19/18	Thu 3/29/18	44											
46		Levees & Floodwalls Reach 19-21:	155 days	Mon 2/5/18	Fri 8/3/18												
47		Top Soil Stripping	3 days	Fri 3/30/18	Mon 4/2/18	42											
48		Clearing & Grubbing	2 days	Tue 4/3/18	Wed 4/4/18	47											
49		Remove AB Surfacing	2 days	Mon 2/5/18	Tue 2/6/18	42SS											
50		Degrade Existing Levees	16 days	Thu 4/5/18	Mon 4/23/18	48											
51		Excavate Cutoff Trench	2 days	Tue 4/17/18	Wed 4/18/18	50SS+10 days											
52		SB Cutoff Wall Conventional	37 days	Tue 4/17/18	Tue 5/29/18	50SS+10 days											
53		SB Cutoff Wall DSM	34 days	Wed 5/30/18	Sat 7/7/18	52											
54		Levee Embankment Fill	27 days	Mon 7/2/18	Wed 8/1/18	53SS+28 days											
55		AB Surfacing Levee Crown	2 days	Thu 8/2/18	Fri 8/3/18	54											
56		Top Soil Replacment	6 days	Sat 7/28/18	Fri 8/3/18	55FF											

Project: Sutter Basin Rev 1
Date: Thu 3/14/13

Task

Split

Progress

Milestone

Summary













Project Summary

External Tasks

External Milestone

Deadline

Page 1

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	1/1	January 21	2/12	3/5	3/26	4/16	May 1	5/7	5/28	June 21	6/18	7/9
57		Construction Year 2	155 days	Thu 2/28/19	Tue 8/27/19														
58		Mob, Demob & Preparatory Work	46 days	Thu 2/28/19	Mon 4/22/19														
59		Submittals	30 days	Thu 2/28/19	Wed 4/3/19														
60		Mobilization	6 days	Thu 4/4/19	Wed 4/10/19	59													
61		Staging Areas Setup	10 days	Thu 4/11/19	Mon 4/22/19	60													
62		Levees & Floodwalls Reach 19-21:	109 days	Tue 4/23/19	Tue 8/27/19														
63		Top Soil Stripping	3 days	Tue 4/23/19	Thu 4/25/19	58													
64		Clearing & Grubbing	2 days	Fri 4/26/19	Sat 4/27/19	63													
65		Remove AB Surfacing	2 days	Tue 4/23/19	Wed 4/24/19	58													
66		Degrade Exisiting Levees	16 days	Mon 4/29/19	Thu 5/16/19	64													
67		Excavate Cutoff Trench	2 days	Fri 5/10/19	Sat 5/11/19	66SS+10 days													
68		SB Cutoff Wall Conventional	37 days	Fri 5/10/19	Fri 6/21/19	66SS+10 days													
69		SB Cutoff Wall DSM	34 days	Sat 6/22/19	Wed 7/31/19	68													
70		Levee Embankment Fill	27 days	Thu 7/25/19	Sat 8/24/19	69SS+28 days													
71		AB Surfacing Levee Crown	2 days	Mon 8/26/19	Tue 8/27/19	70													
72		Top Soil Replacment	6 days	Wed 8/21/19	Tue 8/27/19	71FF													
73		Contract B (7-12)	504 days?	Tue 2/5/19	Mon 9/14/20														
74		Contract B (7-12)	504 days?	Tue 2/5/19	Mon 9/14/20														
75		Contract Award	1 day	Tue 2/5/19	Tue 2/5/19														
76		NTP	1 day	Wed 2/6/19	Wed 2/6/19	75													
77		Construction Year 1	187 days?	Thu 2/7/19	Thu 9/12/19														
78		Mob, Demob & Preparatory Work	46 days	Thu 2/7/19	Mon 4/1/19														
79		Submittals	30 days	Thu 2/7/19	Wed 3/13/19	76													
80		Mobilization	6 days	Thu 3/14/19	Wed 3/20/19	79													
81		Staging Areas Setup	10 days	Thu 3/21/19	Mon 4/1/19	80													
82		Levees & Floodwalls Reach 7-12	141 days?	Tue 4/2/19	Thu 9/12/19														
83		Top Soil Stripping	6 days	Tue 4/2/19	Mon 4/8/19	78													
84		Clearing & Grubbing	5 days	Tue 4/9/19	Sat 4/13/19	83													
85		Remove AB Surfacing	3 days	Fri 6/7/19	Mon 6/10/19	78,86FF													
86		Degrade Exisiting Levees	49 days	Mon 4/15/19	Mon 6/10/19	84													
87		Excavate Cutoff Trench	4 days	Fri 4/26/19	Tue 4/30/19	86SS+10 days													
88		Excavate Inspection/Key Trench	1 day?	Wed 5/8/19	Wed 5/8/19	87SS+10 days													
89		SB Cutoff Wall Conventional	83 days	Fri 4/26/19	Wed 7/31/19	86SS+10 days													
90		Levee Embankment Fill	83 days	Wed 5/29/19	Mon 9/2/19	89SS+28 days													
91		AB Surfacing Levee Crown	9 days	Tue 9/3/19	Thu 9/12/19	90													
92		Top Soil Replacment	12 days	Fri 8/30/19	Thu 9/12/19	91FF													
93		Construction Year 2	157 days?	Mon 3/16/20	Mon 9/14/20														
94		Mob, Demob & Preparatory Work	16 days	Mon 3/16/20	Thu 4/2/20														
95		Mobilization	6 days	Mon 3/16/20	Sat 3/21/20														
96		Staging Areas Setup	10 days	Mon 3/23/20	Thu 4/2/20	95													
97		Levees & Floodwalls Reach 7-12	141 days?	Fri 4/3/20	Mon 9/14/20														
98		Top Soil Stripping	6 days	Fri 4/3/20	Thu 4/9/20	94													
99		Clearing & Grubbing	5 days	Fri 4/10/20	Wed 4/15/20	98													
100		Remove AB Surfacing	3 days	Tue 6/9/20	Thu 6/11/20	94,101FF													
101		Degrade Exisiting Levees	49 days	Thu 4/16/20	Thu 6/11/20	99													
102		Excavate Cutoff Trench	4 days	Tue 4/28/20	Fri 5/1/20	101SS+10 days													
103		Excavate Inspection/Key Trench	1 day?	Sat 5/9/20	Sat 5/9/20	102SS+10 days													
104		SB Cutoff Wall Conventional	83 days	Tue 4/28/20	Sat 8/1/20	101SS+10 days													
105		Levee Embankment Fill	83 days	Sat 5/30/20	Thu 9/3/20	104SS+28 days													
106		AB Surfacing Levee Crown	9 days	Fri 9/4/20	Mon 9/14/20	105													
107		Top Soil Replacment	12 days	Tue 9/1/20	Mon 9/14/20	106FF													
108		Star Bend FIP (6)	425 days?	Tue 2/5/19	Sat 6/13/20														
109		Star Bend FIP (6)	425 days?	Tue 2/5/19	Sat 6/13/20														
110		Contract Award	1 day	Tue 2/5/19	Tue 2/5/19														
111		NTP	1 day	Wed 2/6/19	Wed 2/6/19	110													
112		Construction Year 1	108 days	Thu 2/7/19	Wed 6/12/19														

Project: Sutter Basin Rev 1

Date: Thu 3/14/13

Task

Split

Progress

Milestone

Summary











Project Summary

External Tasks

External Milestone

Deadline

Page 2

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	January 21				March 11		May 1		June 21		
								1/1	1/22	2/12		3/5	3/26	4/16	5/7	5/28	6/18	7/9
113		Mob, Demob & Preparatory Work	46 days	Thu 2/7/19	Mon 4/1/19													
114		Submittals	30 days	Thu 2/7/19	Wed 3/13/19	111												
115		Mobilization	6 days	Thu 3/14/19	Wed 3/20/19	114												
116		Staging Areas Setup	10 days	Thu 3/21/19	Mon 4/1/19	115												
117		Levees & Floodwalls Reach 6	62 days	Tue 4/2/19	Wed 6/12/19													
118		Top Soil Stripping	2 days	Tue 4/2/19	Wed 4/3/19	113												
119		Clearing & Grubbing	2 days	Thu 4/4/19	Fri 4/5/19	118												
120		Degrade Exisiting Levees	10 days	Sat 4/6/19	Wed 4/17/19	119												
121		Excavate Cutoff Trench	1 day	Thu 4/18/19	Thu 4/18/19	120SS+10 days												
122		SB Cutoff Wall Conventional	29 days	Thu 4/18/19	Tue 5/21/19	120SS+10 days												
123		Levee Embankment Fill	18 days	Tue 5/21/19	Mon 6/10/19	122SS+28 days												
124		AB Surfacing Levee Crown	2 days	Tue 6/11/19	Wed 6/12/19	123												
125		Top Soil Replacment	3 days	Mon 6/10/19	Wed 6/12/19	124FF												
126		Construction Year 2	78 days?	Mon 3/16/20	Sat 6/13/20													
127		Mob, Demob & Preparatory Work	16 days	Mon 3/16/20	Thu 4/2/20													
128		Mobilization	6 days	Mon 3/16/20	Sat 3/21/20													
129		Staging Areas Setup	10 days	Mon 3/23/20	Thu 4/2/20	128												
130		Levees & Floodwalls Reach 6	62 days?	Fri 4/3/20	Sat 6/13/20													
131		Top Soil Stripping	2 days	Fri 4/3/20	Sat 4/4/20	127												
132		Clearing & Grubbing	2 days	Mon 4/6/20	Tue 4/7/20	131												
133		Degrade Exisiting Levees	10 days	Wed 4/8/20	Sat 4/18/20	132												
134		Excavate Cutoff Trench	1 day	Mon 4/20/20	Mon 4/20/20	133SS+10 days												
135		Excavate Inspection/Key Trench	1 day?	Fri 5/1/20	Fri 5/1/20	134SS+10 days												
136		SB Cutoff Wall Conventional	29 days	Mon 4/20/20	Fri 5/22/20	133SS+10 days												
137		Levee Embankment Fill	18 days	Fri 5/22/20	Thu 6/11/20	136SS+28 days												
138		AB Surfacing Levee Crown	2 days	Fri 6/12/20	Sat 6/13/20	137												
139		Top Soil Replacment	3 days	Thu 6/11/20	Sat 6/13/20	138FF												
140		Contract A (2-5)	506 days	Tue 2/4/20	Wed 9/15/21													
141		Contract A (2-5)	506 days	Tue 2/4/20	Wed 9/15/21													
142		Contract Award	1 day	Tue 2/4/20	Tue 2/4/20													
143		NTP	1 day	Wed 2/5/20	Wed 2/5/20	142												
144		Construction Year 1	188 days	Thu 2/6/20	Fri 9/11/20													
145		Mob, Demob & Preparatory Work	46 days	Thu 2/6/20	Mon 3/30/20													
146		Submittals	30 days	Thu 2/6/20	Wed 3/11/20	143												
147		Mobilization	6 days	Thu 3/12/20	Wed 3/18/20	146												
148		Staging Areas Setup	10 days	Thu 3/19/20	Mon 3/30/20	147												
149		Levees & Floodwalls Reach 2-5:	142 days	Tue 3/31/20	Fri 9/11/20													
150		Top Soil Stripping	8 days	Tue 3/31/20	Wed 4/8/20	145												
151		Clearing & Grubbing	6 days	Thu 4/9/20	Wed 4/15/20	150												
152		Remove AB Surfacing	3 days	Tue 3/31/20	Thu 4/2/20	145												
153		Degrade Exisiting Levees	46 days	Thu 4/16/20	Mon 6/8/20	151												
154		Excavate Cutoff Trench	4 days	Tue 4/28/20	Fri 5/1/20	153SS+10 days												
155		Excavate Inspection/Key Trench	4 days	Sat 5/9/20	Wed 5/13/20	154SS+10 days												
156		SB Cutoff Wall Conventional	51 days	Tue 4/28/20	Thu 6/25/20	153SS+10 days												
157		SB Cutoff Wall DSM	67 days	Fri 6/26/20	Fri 9/11/20	156												
158		Levee Embankment Fill	82 days	Sat 5/30/20	Wed 9/2/20	156SS+28 days												
159		AB Surfacing Levee Crown	5 days	Thu 9/3/20	Tue 9/8/20	158												
160		Top Soil Replacment	8 days	Mon 8/31/20	Tue 9/8/20	159FF												
161		Construction Year 2	158 days	Tue 3/16/21	Wed 9/15/21													
162		Mob, Demob & Preparatory Work	16 days	Tue 3/16/21	Fri 4/2/21													
163		Mobilization	6 days	Tue 3/16/21	Mon 3/22/21													
164		Staging Areas Setup	10 days	Tue 3/23/21	Fri 4/2/21	163												
165		Levees & Floodwalls Reach 2-5	142 days	Sat 4/3/21	Wed 9/15/21													
166		Top Soil Stripping	8 days	Sat 4/3/21	Mon 4/12/21	162												
167		Clearing & Grubbing	6 days	Tue 4/13/21	Mon 4/19/21	166												
168		Remove AB Surfacing	3 days	Sat 4/3/21	Tue 4/6/21	162												

Project: Sutter Basin Rev 1
Date: Thu 3/14/13

Task

Split

Progress

Milestone

Summary


Project Summary

External Tasks

External Milestone

Deadline

Page 3

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	January 21				March 11			May 1		June 21	
								1/1	1/22	2/12		3/5	3/26	4/16	5/7	5/28	6/18	7/9
169		Degrade Exisiting Levees	46 days	Tue 4/20/21	Fri 6/11/21	167												
170		Excavate Cutoff Trench	4 days	Sat 5/1/21	Wed 5/5/21	169SS+10 days												
171		Excavate Inspection/Key Trench	4 days	Thu 5/13/21	Mon 5/17/21	170SS+10 days												
172		SB Cutoff Wall Conventional	51 days	Sat 5/1/21	Tue 6/29/21	169SS+10 days												
173		SB Cutoff Wall DSM	67 days	Wed 6/30/21	Wed 9/15/21	172												
174		Levee Embankment Fill	82 days	Thu 6/3/21	Mon 9/6/21	172SS+28 days												
175		AB Surfacing Levee Crown	5 days	Tue 9/7/21	Sat 9/11/21	174												
176		Top Soil Replacment	8 days	Fri 9/3/21	Sat 9/11/21	175FF												

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	1/1	January 21	March 11	May 1	June 21	Au					
									1/22	2/12	3/5	3/26	4/16	5/7	5/28	6/18	7/9	7/30
1		Sutter Basin SB-8	2071 days?	Fri 2/3/17	Fri 9/15/23													
2		Contract C (13-25)	865 days?	Fri 2/3/17	Fri 11/8/19													
3		Contract C1 (13-18)	539 days?	Fri 2/3/17	Wed 10/24/18													
4		Contract Award	1 day	Fri 2/3/17	Fri 2/3/17													
5		NTP	1 day	Sat 2/4/17	Sat 2/4/17	4												
6		Construction Year 1	279 days?	Mon 2/6/17	Wed 12/27/17													
7		Mob, Demob & Preparatory Work	46 days	Mon 2/6/17	Thu 3/30/17													
8		Submittals	30 days	Mon 2/6/17	Sat 3/11/17	5												
9		Mobilization	6 days	Mon 3/13/17	Sat 3/18/17	8												
10		Staging Areas Setup	10 days	Mon 3/20/17	Thu 3/30/17	9												
11		Levees & Floodwalls Reach 13 - 18:	279 days?	Mon 2/6/17	Wed 12/27/17													
12		Top Soil Stripping	4 days	Fri 3/31/17	Tue 4/4/17	7												
13		Clearing & Grubbing	4 days	Wed 4/5/17	Sat 4/8/17	12												
14		Remove AB Surfacing	4 days	Mon 2/6/17	Thu 2/9/17	7SS												
15		Degrade Exisiting Levees	42 days	Mon 4/10/17	Sat 5/27/17	13												
16		SB Cutoff Wall Conventional	24 days	Fri 4/21/17	Thu 5/18/17	15SS+10 days												
17		SB Cutoff Wall DSM	87 days	Fri 5/19/17	Mon 8/28/17	16												
18		Jet Grouting	18 days	Tue 8/29/17	Mon 9/18/17	17												
19		Levee Embankment Fill	76 days	Sat 9/30/17	Wed 12/27/17	18SS+28 days												
20		Top Soil Replacment	4 days	Sat 12/23/17	Wed 12/27/17	19FF												
21		AB Surfacing Levee Crown	1 day	Wed 12/27/17	Wed 12/27/17	19FF												
22		Relief Well Conveyance Ditch	1 day?	Wed 12/27/17	Wed 12/27/17	19FF												
23		Construction Year 2	191 days	Fri 3/16/18	Wed 10/24/18													
24		Mob, Demob & Preparatory Work	16 days	Fri 3/16/18	Tue 4/3/18													
25		Mobilization	6 days	Fri 3/16/18	Thu 3/22/18													
26		Staging Areas Setup	10 days	Fri 3/23/18	Tue 4/3/18	25												
27		Levees & Floodwalls Reach 13 - 18:	191 days	Fri 3/16/18	Wed 10/24/18													
28		Top Soil Stripping	4 days	Wed 4/4/18	Sat 4/7/18	24												
29		Clearing & Grubbing	4 days	Mon 4/9/18	Thu 4/12/18	28												
30		Remove AB Surfacing	4 days	Fri 3/16/18	Tue 3/20/18	24SS												
31		Degrade Exisiting Levees	42 days	Fri 4/13/18	Thu 5/31/18	29												
32		SB Cutoff Wall Conventional	24 days	Wed 4/25/18	Tue 5/22/18	31SS+10 days												
33		SB Cutoff Wall DSM	87 days	Wed 5/23/18	Fri 8/31/18	32												
34		Jet Grouting	18 days	Sat 9/1/18	Fri 9/21/18	33												
35		Levee Embankment Fill	76 days	Sat 7/28/18	Wed 10/24/18	34FF+28 days												
36		Top Soil Replacment	4 days	Sat 10/20/18	Wed 10/24/18	35FF												
37		AB Surfacing Levee Crown	1 day	Wed 10/24/18	Wed 10/24/18	36FF												
38		Contract C2 (19-25)	553 days	Fri 2/2/18	Fri 11/8/19													
39		Contract Award	1 day	Fri 2/2/18	Fri 2/2/18													
40		NTP	1 day	Sat 2/3/18	Sat 2/3/18	39												
41		Construction Year 1	218 days	Mon 2/5/18	Tue 10/16/18													
42		Mob, Demob & Preparatory Work	46 days	Mon 2/5/18	Thu 3/29/18													
43		Submittals	30 days	Mon 2/5/18	Sat 3/10/18	40												
44		Mobilization	6 days	Mon 3/12/18	Sat 3/17/18	43												
45		Staging Areas Setup	10 days	Mon 3/19/18	Thu 3/29/18	44												
46		Levees & Floodwalls Reach 19-25:	218 days	Mon 2/5/18	Tue 10/16/18													
47		Top Soil Stripping	5 days	Fri 3/30/18	Wed 4/4/18	42												
48		Clearing & Grubbing	4 days	Thu 4/5/18	Mon 4/9/18	47												
49		Remove AB Surfacing	4 days	Mon 2/5/18	Thu 2/8/18	42SS												
50		Degrade Exisiting Levees	26 days	Tue 4/10/18	Wed 5/9/18	48												
51		Excavate Cutoff Trench	5 days	Sat 4/21/18	Thu 4/26/18	50SS+10 days												
52		Excavate Inspection/Key Trench	3 days	Thu 5/3/18	Sat 5/5/18	51SS+10 days												
53		SB Cutoff Wall Conventional	67 days	Sat 4/21/18	Sat 7/7/18	50SS+10 days												
54		SB Cutoff Wall DSM	34 days	Mon 7/9/18	Thu 8/16/18	53												
55		Levee Embankment Fill	53 days	Fri 8/10/18	Wed 10/10/18	54SS+28 days												
56		AB Surfacing Levee Crown	5 days	Thu 10/11/18	Tue 10/16/18	55												

Project: Sutter Basin Rev 1
Date: Thu 3/14/13

Task

Progress

Summary

External Tasks

Deadline










Split

Milestone

Project Summary

External Milestone

Page 1

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	1/1	January 21	March 11	May 1	June 21	Au
57		Top Soil Replacment	10 days	Fri 10/5/18	Tue 10/16/18	56FF							
58		Construction Year 2	218 days	Thu 2/28/19	Fri 11/8/19								
59		Mob, Demob & Preparatory Work	46 days	Thu 2/28/19	Mon 4/22/19								
60		Submittals	30 days	Thu 2/28/19	Wed 4/3/19								
61		Mobilization	6 days	Thu 4/4/19	Wed 4/10/19	60							
62		Staging Areas Setup	10 days	Thu 4/11/19	Mon 4/22/19	61							
63		Levees & Floodwalls Reach 19-25:	172 days	Tue 4/23/19	Fri 11/8/19								
64		Top Soil Stripping	5 days	Tue 4/23/19	Sat 4/27/19	59							
65		Clearing & Grubbing	4 days	Mon 4/29/19	Thu 5/2/19	64							
66		Remove AB Surfacing	4 days	Tue 4/23/19	Fri 4/26/19	59							
67		Degrade Exisiting Levees	26 days	Fri 5/3/19	Sat 6/1/19	65							
68		Excavate Cutoff Trench	5 days	Wed 5/15/19	Mon 5/20/19	67SS+10 days							
69		Excavate Inspection/Key Trench	5 days	Mon 5/27/19	Fri 5/31/19	68SS+10 days							
70		SB Cutoff Wall Conventional	67 days	Wed 5/15/19	Wed 7/31/19	67SS+10 days							
71		SB Cutoff Wall DSM	34 days	Thu 8/1/19	Mon 9/9/19	70							
72		Levee Embankment Fill	53 days	Tue 9/3/19	Sat 11/2/19	71SS+28 days							
73		AB Surfacing Levee Crown	5 days	Mon 11/4/19	Fri 11/8/19	72							
74		Top Soil Replacment	10 days	Tue 10/29/19	Fri 11/8/19	73FF							
75		Contract D (26-41)	793 days	Mon 2/4/19	Mon 8/16/21								
76		Contract D1 (26-33)	541 days	Mon 2/4/19	Mon 10/26/20								
77		Contract Award	1 day	Mon 2/4/19	Mon 2/4/19								
78		NTP	1 day	Tue 2/5/19	Tue 2/5/19	77							
79		Construction Year 1	228 days	Wed 2/6/19	Tue 10/29/19								
80		Mob, Demob & Preparatory Work	46 days	Wed 2/6/19	Sat 3/30/19								
81		Submittals	30 days	Wed 2/6/19	Tue 3/12/19	78							
82		Mobilization	6 days	Wed 3/13/19	Tue 3/19/19	81							
83		Staging Areas Setup	10 days	Wed 3/20/19	Sat 3/30/19	82							
84		Levees & Floodwalls Reach 26-33:	228 days	Wed 2/6/19	Tue 10/29/19								
85		Top Soil Stripping	4 days	Mon 4/1/19	Thu 4/4/19	80							
86		Clearing & Grubbing	3 days	Fri 4/5/19	Mon 4/8/19	85							
87		Remove AB Surfacing	3 days	Wed 2/6/19	Fri 2/8/19	80SS							
88		Degrade Exisiting Levees	17 days	Tue 4/9/19	Sat 4/27/19	86							
89		Excavate Cutoff Trench	4 days	Sat 4/20/19	Wed 4/24/19	88SS+10 days							
90		Excavate Inspection/Key Trench	5 days	Thu 5/2/19	Tue 5/7/19	89SS+10 days							
91		SB Cutoff Wall Conventional	68 days	Sat 4/20/19	Mon 7/8/19	88SS+10 days							
92		SB Cutoff Wall DSM	60 days	Tue 7/9/19	Mon 9/16/19	91							
93		Jet Grouting	20 days	Sat 8/24/19	Mon 9/16/19	92FF							
94		Levee Embankment Fill	61 days	Fri 8/9/19	Fri 10/18/19	91SS+28 days,93							
95		AB Surfacing Levee Crown	4 days	Sat 10/19/19	Wed 10/23/19	94							
96		Top Soil Replacment	7 days	Wed 10/16/19	Wed 10/23/19	95FF							
97		Canal @ STA 1753+00	17 days	Thu 10/10/19	Tue 10/29/19								
98		Construction New Canal	8 days	Thu 10/10/19	Fri 10/18/19	86,94FF							
99		Backfill Old Canal	9 days	Sat 10/19/19	Tue 10/29/19	98							
100		Construction Year 2	193 days	Mon 3/16/20	Mon 10/26/20								
101		Mob, Demob & Preparatory Work	16 days	Mon 3/16/20	Thu 4/2/20								
102		Mobilization	6 days	Mon 3/16/20	Sat 3/21/20								
103		Staging Areas Setup	10 days	Mon 3/23/20	Thu 4/2/20	102							
104		Levees & Floodwalls Reach 26-33	193 days	Mon 3/16/20	Mon 10/26/20								
105		Top Soil Stripping	4 days	Fri 4/3/20	Tue 4/7/20	101							
106		Clearing & Grubbing	3 days	Wed 4/8/20	Fri 4/10/20	105							
107		Remove AB Surfacing	3 days	Mon 3/16/20	Wed 3/18/20	101SS							
108		Degrade Exisiting Levees	17 days	Sat 4/11/20	Thu 4/30/20	106							
109		Excavate Cutoff Trench	4 days	Thu 4/23/20	Mon 4/27/20	108SS+10 days							
110		Excavate Inspection/Key Trench	5 days	Tue 5/5/20	Sat 5/9/20	109SS+10 days							
111		SB Cutoff Wall Conventional	68 days	Thu 4/23/20	Fri 7/10/20	108SS+10 days							
112		SB Cutoff Wall DSM	60 days	Sat 7/11/20	Fri 9/18/20	111							

Project: Sutter Basin Rev 1
Date: Thu 3/14/13

Task

Split

Progress

Milestone

Summary












Project Summary












External Tasks

External Milestone

Deadline

Page 2

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	January 21			March 11		May 1		June 21		Au
								1/1	1/22	2/12	3/5	3/26	4/16	5/7	5/28	6/18	
113		Jet Grouting	20 days	Thu 8/27/20	Fri 9/18/20	112FF											
114		Levee Embankment Fill	61 days	Wed 8/12/20	Wed 10/21/20	111SS+28 days,1											
115		AB Surfacing Levee Crown	4 days	Thu 10/22/20	Mon 10/26/20	114											
116		Top Soil Replacment	7 days	Mon 10/19/20	Mon 10/26/20	115FF											
117		Contract D2 (34-41)	481 days	Mon 2/3/20	Mon 8/16/21												
118		Contract Award	1 day	Mon 2/3/20	Mon 2/3/20												
119		NTP	1 day	Tue 2/4/20	Tue 2/4/20	118											
120		Construction Year 1	163 days	Wed 2/5/20	Wed 8/12/20												
121		Mob, Demob & Preparatory Work	46 days	Wed 2/5/20	Sat 3/28/20												
122		Submittals	30 days	Wed 2/5/20	Tue 3/10/20	119											
123		Mobilization	6 days	Wed 3/11/20	Tue 3/17/20	122											
124		Staging Areas Setup	10 days	Wed 3/18/20	Sat 3/28/20	123											
125		Levees & Floodwalls Reach 34-41	117 days	Mon 3/30/20	Wed 8/12/20												
126		Top Soil Stripping	4 days	Mon 3/30/20	Thu 4/2/20	121											
127		Clearing & Grubbing	5 days	Fri 4/3/20	Wed 4/8/20	126											
128		Remove AB Surfacing	2 days	Sat 5/2/20	Mon 5/4/20	121,129FF											
129		Degrade Exisiting Levees	22 days	Thu 4/9/20	Mon 5/4/20	127											
130		Excavate Cutoff Trench	3 days	Tue 4/21/20	Thu 4/23/20	129SS+10 days											
131		SB Cutoff Wall Conventional	31 days	Tue 4/21/20	Tue 5/26/20	129SS+10 days											
132		SB Cutoff Wall DSM	67 days	Wed 5/27/20	Wed 8/12/20	131											
133		Levee Embankment Fill	23 days	Sat 5/23/20	Thu 6/18/20	131SS+28 days											
134		AB Surfacing Levee Crown	3 days	Fri 6/19/20	Mon 6/22/20	133											
135		Top Soil Replacment	7 days	Mon 6/15/20	Mon 6/22/20	134FF											
136		Construction Year 2	133 days	Mon 3/15/21	Mon 8/16/21												
137		Mob, Demob & Preparatory Work	16 days	Mon 3/15/21	Thu 4/1/21												
138		Mobilization	6 days	Mon 3/15/21	Sat 3/20/21												
139		Staging Areas Setup	10 days	Mon 3/22/21	Thu 4/1/21	138											
140		Levees & Floodwalls Reach 34-41	117 days	Fri 4/2/21	Mon 8/16/21												
141		Top Soil Stripping	4 days	Fri 4/2/21	Tue 4/6/21	137											
142		Clearing & Grubbing	5 days	Wed 4/7/21	Mon 4/12/21	141											
143		Remove AB Surfacing	2 days	Thu 5/6/21	Fri 5/7/21	137,144FF											
144		Degrade Exisiting Levees	22 days	Tue 4/13/21	Fri 5/7/21	142											
145		Excavate Cutoff Trench	3 days	Sat 4/24/21	Tue 4/27/21	144SS+10 days											
146		SB Cutoff Wall Conventional	31 days	Sat 4/24/21	Sat 5/29/21	144SS+10 days											
147		SB Cutoff Wall DSM	67 days	Mon 5/31/21	Mon 8/16/21	146											
148		Levee Embankment Fill	23 days	Thu 5/27/21	Tue 6/22/21	146SS+28 days											
149		AB Surfacing Levee Crown	3 days	Wed 6/23/21	Fri 6/25/21	148											
150		Top Soil Replacment	7 days	Fri 6/18/21	Fri 6/25/21	149FF											
151		Contract B (7-12)	503 days?	Fri 2/5/21	Wed 9/14/22												
152		Contract B (7-12)	503 days?	Fri 2/5/21	Wed 9/14/22												
153		Contract Award	1 day	Fri 2/5/21	Fri 2/5/21												
154		NTP	1 day	Sat 2/6/21	Sat 2/6/21	153											
155		Construction Year 1	187 days?	Mon 2/8/21	Mon 9/13/21												
156		Mob, Demob & Preparatory Work	46 days	Mon 2/8/21	Thu 4/1/21												
157		Submittals	30 days	Mon 2/8/21	Sat 3/13/21	154											
158		Mobilization	6 days	Mon 3/15/21	Sat 3/20/21	157											
159		Staging Areas Setup	10 days	Mon 3/22/21	Thu 4/1/21	158											
160		Levees & Floodwalls Reach 7-12	141 days?	Fri 4/2/21	Mon 9/13/21												
161		Top Soil Stripping	6 days	Fri 4/2/21	Thu 4/8/21	156											
162		Clearing & Grubbing	5 days	Fri 4/9/21	Wed 4/14/21	161											
163		Remove AB Surfacing	3 days	Tue 6/8/21	Thu 6/10/21	156,164FF											
164		Degrade Exisiting Levees	49 days	Thu 4/15/21	Thu 6/10/21	162											
165		Excavate Cutoff Trench	4 days	Tue 4/27/21	Fri 4/30/21	164SS+10 days											
166		Excavate Inspection/Key Trench	1 day?	Sat 5/8/21	Sat 5/8/21	165SS+10 days											
167		SB Cutoff Wall Conventional	83 days	Tue 4/27/21	Sat 7/31/21	164SS+10 days											
168		Levee Embankment Fill	83 days	Sat 5/29/21	Thu 9/2/21	167SS+28 days											
Project: Sutter Basin Rev 1 Date: Thu 3/14/13		Task Split	<div><div></div></div> <div><div></div></div>	Progress Milestone	<div><div></div></div> <div><div></div></div>	Summary Project Summary	<div><div></div></div> <div><div></div></div>	External Tasks External Milestone	<div><div></div></div> <div><div></div></div>	Deadline	<div><div></div></div>						
Page 3																	

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	January 21			March 11			May 1		June 21			Au
								1/1	1/22	2/12		3/5	3/26	4/16	5/7	5/28	6/18	7/9	7/30
169		AB Surfacing Levee Crown	9 days	Fri 9/3/21	Mon 9/13/21	168													
170		Top Soil Replacment	12 days	Tue 8/31/21	Mon 9/13/21	169FF													
171		Construction Year 2	157 days?	Wed 3/16/22	Wed 9/14/22														
172		Mob, Demob & Preparatory Work	16 days	Wed 3/16/22	Sat 4/2/22														
173		Mobilization	6 days	Wed 3/16/22	Tue 3/22/22														
174		Staging Areas Setup	10 days	Wed 3/23/22	Sat 4/2/22	173													
175		Levees & Floodwalls Reach 7-12	141 days?	Mon 4/4/22	Wed 9/14/22														
176		Top Soil Stripping	6 days	Mon 4/4/22	Sat 4/9/22	172													
177		Clearing & Grubbing	5 days	Mon 4/11/22	Fri 4/15/22	176													
178		Remove AB Surfacing	3 days	Thu 6/9/22	Sat 6/11/22	172,179FF													
179		Degrade Exisiting Levees	49 days	Sat 4/16/22	Sat 6/11/22	177													
180		Excavate Cutoff Trench	4 days	Thu 4/28/22	Mon 5/2/22	179SS+10 days													
181		Excavate Inspection/Key Trench	1 day?	Tue 5/10/22	Tue 5/10/22	180SS+10 days													
182		SB Cutoff Wall Conventional	83 days	Thu 4/28/22	Tue 8/2/22	179SS+10 days													
183		Levee Embankment Fill	83 days	Tue 5/31/22	Sat 9/3/22	182SS+28 days													
184		AB Surfacing Levee Crown	9 days	Mon 9/5/22	Wed 9/14/22	183													
185		Top Soil Replacment	12 days	Thu 9/1/22	Wed 9/14/22	184FF													
186		Star Bend FIP (6)	424 days?	Fri 2/5/21	Tue 6/14/22														
187		Star Bend FIP (6)	424 days?	Fri 2/5/21	Tue 6/14/22														
188		Contract Award	1 day	Fri 2/5/21	Fri 2/5/21														
189		NTP	1 day	Sat 2/6/21	Sat 2/6/21	188													
190		Construction Year 1	108 days	Mon 2/8/21	Sat 6/12/21														
191		Mob, Demob & Preparatory Work	46 days	Mon 2/8/21	Thu 4/1/21														
192		Submittals	30 days	Mon 2/8/21	Sat 3/13/21	189													
193		Mobilization	6 days	Mon 3/15/21	Sat 3/20/21	192													
194		Staging Areas Setup	10 days	Mon 3/22/21	Thu 4/1/21	193													
195		Levees & Floodwalls Reach 6	62 days	Fri 4/2/21	Sat 6/12/21														
196		Top Soil Stripping	2 days	Fri 4/2/21	Sat 4/3/21	191													
197		Clearing & Grubbing	2 days	Mon 4/5/21	Tue 4/6/21	196													
198		Degrade Exisiting Levees	10 days	Wed 4/7/21	Sat 4/17/21	197													
199		Excavate Cutoff Trench	1 day	Mon 4/19/21	Mon 4/19/21	198SS+10 days													
200		SB Cutoff Wall Conventional	29 days	Mon 4/19/21	Fri 5/21/21	198SS+10 days													
201		Levee Embankment Fill	18 days	Fri 5/21/21	Thu 6/10/21	200SS+28 days													
202		AB Surfacing Levee Crown	2 days	Fri 6/11/21	Sat 6/12/21	201													
203		Top Soil Replacment	3 days	Thu 6/10/21	Sat 6/12/21	202FF													
204		Construction Year 2	78 days?	Wed 3/16/22	Tue 6/14/22														
205		Mob, Demob & Preparatory Work	16 days	Wed 3/16/22	Sat 4/2/22														
206		Mobilization	6 days	Wed 3/16/22	Tue 3/22/22														
207		Staging Areas Setup	10 days	Wed 3/23/22	Sat 4/2/22	206													
208		Levees & Floodwalls Reach 6	62 days?	Mon 4/4/22	Tue 6/14/22														
209		Top Soil Stripping	2 days	Mon 4/4/22	Tue 4/5/22	205													
210		Clearing & Grubbing	2 days	Wed 4/6/22	Thu 4/7/22	209													
211		Degrade Exisiting Levees	10 days	Fri 4/8/22	Tue 4/19/22	210													
212		Excavate Cutoff Trench	1 day	Wed 4/20/22	Wed 4/20/22	211SS+10 days													
213		Excavate Inspection/Key Trench	1 day?	Mon 5/2/22	Mon 5/2/22	212SS+10 days													
214		SB Cutoff Wall Conventional	29 days	Wed 4/20/22	Mon 5/23/22	211SS+10 days													
215		Levee Embankment Fill	18 days	Mon 5/23/22	Sat 6/11/22	214SS+28 days													
216		AB Surfacing Levee Crown	2 days	Mon 6/13/22	Tue 6/14/22	215													
217		Top Soil Replacment	3 days	Sat 6/11/22	Tue 6/14/22	216FF													
218		Contract A (2-5)	505 days	Fri 2/4/22	Fri 9/15/23														
219		Contract A (2-5)	505 days	Fri 2/4/22	Fri 9/15/23														
220		Contract Award	1 day	Fri 2/4/22	Fri 2/4/22														
221		NTP	1 day	Sat 2/5/22	Sat 2/5/22	220													
222		Construction Year 1	188 days	Mon 2/7/22	Tue 9/13/22														
223		Mob, Demob & Preparatory Work	46 days	Mon 2/7/22	Thu 3/31/22														
224		Submittals	30 days	Mon 2/7/22	Sat 3/12/22	221													

Project: Sutter Basin Rev 1

Date: Thu 3/14/13

Task

Split

Progress

Milestone

Summary





Project Summary

External Tasks

External Milestone

Deadline

Page 4

ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names	January 21				March 11			May 1		June 21			Au
								1/1	1/22	2/12		3/5	3/26	4/16	5/7	5/28	6/18	7/9	7/30	
225		Mobilization	6 days	Mon 3/14/22	Sat 3/19/22	224														
226		Staging Areas Setup	10 days	Mon 3/21/22	Thu 3/31/22	225														
227		Levees & Floodwalls Reach 2-5:	142 days	Fri 4/1/22	Tue 9/13/22															
228		Top Soil Stripping	8 days	Fri 4/1/22	Sat 4/9/22	223														
229		Clearing & Grubbing	6 days	Mon 4/11/22	Sat 4/16/22	228														
230		Remove AB Surfacing	3 days	Fri 4/1/22	Mon 4/4/22	223														
231		Degrade Exisiting Levees	46 days	Mon 4/18/22	Thu 6/9/22	229														
232		Excavate Cutoff Trench	4 days	Fri 4/29/22	Tue 5/3/22	231SS+10 days														
233		Excavate Inspection/Key Trench	4 days	Wed 5/11/22	Sat 5/14/22	232SS+10 days														
234		SB Cutoff Wall Conventional	51 days	Fri 4/29/22	Mon 6/27/22	231SS+10 days														
235		SB Cutoff Wall DSM	67 days	Tue 6/28/22	Tue 9/13/22	234														
236		Levee Embankment Fill	82 days	Wed 6/1/22	Sat 9/3/22	234SS+28 days														
237		AB Surfacing Levee Crown	5 days	Mon 9/5/22	Fri 9/9/22	236														
238		Top Soil Replacment	8 days	Thu 9/1/22	Fri 9/9/22	237FF														
239		Construction Year 2	158 days	Thu 3/16/23	Fri 9/15/23															
240		Mob, Demob & Preparatory Work	16 days	Thu 3/16/23	Mon 4/3/23															
241		Mobilization	6 days	Thu 3/16/23	Wed 3/22/23															
242		Staging Areas Setup	10 days	Thu 3/23/23	Mon 4/3/23	241														
243		Levees & Floodwalls Reach 2-5	142 days	Tue 4/4/23	Fri 9/15/23															
244		Top Soil Stripping	8 days	Tue 4/4/23	Wed 4/12/23	240														
245		Clearing & Grubbing	6 days	Thu 4/13/23	Wed 4/19/23	244														
246		Remove AB Surfacing	3 days	Tue 4/4/23	Thu 4/6/23	240														
247		Degrade Exisiting Levees	46 days	Thu 4/20/23	Mon 6/12/23	245														
248		Excavate Cutoff Trench	4 days	Tue 5/2/23	Fri 5/5/23	247SS+10 days														
249		Excavate Inspection/Key Trench	4 days	Sat 5/13/23	Wed 5/17/23	248SS+10 days														
250		SB Cutoff Wall Conventional	51 days	Tue 5/2/23	Thu 6/29/23	247SS+10 days														
251		SB Cutoff Wall DSM	67 days	Fri 6/30/23	Fri 9/15/23	250														
252		Levee Embankment Fill	82 days	Sat 6/3/23	Wed 9/6/23	250SS+28 days														
253		AB Surfacing Levee Crown	5 days	Thu 9/7/23	Tue 9/12/23	252														
254		Top Soil Replacment	8 days	Mon 9/4/23	Tue 9/12/23	253FF														





**US Army Corps
of Engineers®**

**Sutter Basin Feasibility Study
Alternative Selection Plans
Project Cost and Schedule Risk Analysis Report**

Prepared for:

U.S. Army Corps of Engineers,
Sacramento District

Prepared with:

U.S. Army Corps of Engineers
Cost Engineering Mandatory Center of Expertise, Walla Walla

August 1, 2013

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
MAIN REPORT	5
1.0 PURPOSE	5
2.0 BACKGROUND	5
3.0 REPORT SCOPE	5
3.1 Project Scope	6
3.2 USACE Risk Analysis Process	6
4.0 METHODOLOGY / PROCESS	7
4.1 Identify and Assess Risk Factors	8
4.2 Quantify Risk Factor Impacts	9
4.3 Analyze Cost Estimate and Schedule Contingency	9
5.0 PROJECT ASSUMPTIONS	10
6.0 RESULTS	11
6.1 Risk Register	11
6.2 Cost Contingency and Sensitivity Analysis	12
6.2.1 Sensitivity Analysis	13
6.2.2 Sensitivity Analysis Results	13
6.3 Schedule Contingency and Sensitivity Analysis	12
7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS	19
7.1 Major Findings/Observations	19
7.2 Recommendations	21

LIST OF TABLES

Table ES-1. Contingency Analysis.....	ES-2
Table 1. Construction Cost Contingency Summary	13
Table 2. Schedule Duration Contingency Summary	17
Table 3. Project Cost Comparison Summary (Uncertainty Analysis)	21

LIST OF FIGURES

Figure 1. Cost Sensitivity Analysis.....	15
Figure 2. Schedule Sensitivity Analysis	18

LIST OF APPENDICES

Risk Register	APPENDIX A
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EXECUTIVE SUMMARY

The US Army Corps of Engineers (USACE), Sacramento District presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Sutter Basin Feasibility Study for two Alternatives (SB7 and SB8). In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the total project cost. The purpose of this risk analysis study is to present the cost and schedule risks considered, those determined and respective project contingencies at a recommend 80% confidence level of successful execution to project completion.

The Sutter Basin Study consists of levee remediations necessary to reduce flood risk to the Sutter Basin. The vast majority of levee remediation consists of seepage prevention by constructing a soil-bentonite slurry cutoff wall through the centerline of the levee and rebuild the levee to pre-project geometry.

The Sutter Basin Feasibility Study considers three (3) Alternatives; Do Nothing; SB7, a Fix-in-Place alternative running for the Feather River West Levee from Sunset Weir to Laurel Avenue; and SB8, a Fix-in-Place alternative for the Feather River West Levee running from Thermalito Afterbay to Laurel Avenue (essentially SB7 plus the additional length from Thermalito Afterbay to Sunset Weir).

Specific to the Sutter Basin project, the base case construction cost for

- SB7 (excluding Accounts 01 Lands and Damages, 02 Fish and Wildlife Facilities, 30 Planning, Engineering and Design and 31 Construction Management) is estimated at approximately \$194 Million. Based on the results of the analysis, the Cost Engineering Mandatory Center of Expertise for Civil Works (Walla Walla District) recommends a contingency value of approximately \$70.5 Million, or 36%.
- SB8 (excluding Accounts 01 Lands and Damages, 02 Fish and Wildlife Facilities, 30 Planning, Engineering and Design and 31 Construction Management) is estimated at approximately \$364 Million. Based on the results of the analysis, the Cost Engineering Mandatory Center of Expertise for Civil Works (Walla Walla District) recommends a contingency value of approximately \$126.4 Million, or 35%.

In conjunction with the Sacramento team, the Cost Engineering Mandatory Center of Expertise (MCX) for Civil Works performed risk analysis by applying the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following tables ES-1 and ES-2 portray the developed contingencies for both alternatives and resulting approximate project costs. The recommended contingencies are based on an 80% confidence level, as per USACE Civil Works guidance. The following tables are not an exact replica of the final reported Total Project costs due to rounding and late cost adjustments. The calculated contingencies are approximate and reflective of those items and cost studied. The following cost accounts were excluded for the risk study:

- The 01-Lands and Damages and the 06-Fish and Wildlife contingencies were established outside of the risk model.
- The 30-Preconstruction, Engineering and Design and the 31-Construction Management carry the same % of contingency value as construction; the theory being is that as constructions cost are impacted, so are these two respective accounts.

Table ES-1A. Contingency Analysis Table – Alternative SB7

Base Cost Estimate	\$194,048,000	
Confidence Level	Value (\$\$)	Contingency (%)
5%	\$33,495,693	17.26%
50%	\$56,363,817	29.05%
80%	\$70,533,025	36.35%
95%	\$83,658,086	43.11%

Table ES-1B. Contingency Analysis Table – Alternative SB8

Base Cost Estimate	\$363,638,000	
Confidence Level	Value (\$\$)	Contingency (%)
5%	\$59,186,930	16.28%
50%	\$100,985,958	27.77%
80%	\$126,390,500	34.76%
95%	\$149,857,593	41.21%

The risk analysis and resulting contingencies are presented as both a cost in dollars and a per cent of the base costs. The risk analysis was performed on a specific cost at a specific point in time. Subtle changes in the costs used to support the risk analysis do not have a significant bearing on contingency dollars or per cent when risk remains constant. As costs fluctuate to a slight degree and risks remain constant, greater emphasis is placed on the per cent value.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis for both Alternatives SB7 and SB8 are CA-3 (Availability of Qualified Contractors) and CA-1 (Multiple Construction Contracts), which together contribute some 69 percent of the statistical cost variance.

- Availability of Qualified Contractors. Captures the risk of limited competition. Multiple other contracts with similar seepage cutoff wall construction could be ongoing at time of contract award, potentially limiting the pool of contractors available to perform the work, impacting the ultimate contract costs.
- Multiple Construction Contracts. Captures the risk funding constraints will require multiple construction contracts, resulting in construction inefficiencies (multiple mob/demobs) and increasing contract oversight and administration costs.

Moderate cost risks, when combined, can also become a cost impact. The greater moderate risks include:

- Availability of suitable Borrow Sources.
- Potential Future Construction Claims and Modifications
- Potential System Wide Improvement Framework (SWIF) Requirements
- Funding Delays

The key schedule risk drivers identified through sensitivity analysis both Alternatives SB7 and SB8 are CA-1 (Multiple Construction Contracts) and PPM-2 (Vertical Team Review and Approval), which together contribute some 72 percent of the statistical schedule variance.

- Multiple Construction Contracts captures the risk funding constraints will require multiple non-concurrent construction contracts, extending the time required to complete the total project.
- Vertical Team Review and Approval captures the risk high time demands on vertical teams have created a backlog of projects and resulting in the potential for delays in the approval process and subsequent schedule slips.
- Funding Delays captures the possible delays in availability in Federal funds and the resulting issues that a protracted construction schedule can place the project at greater risks related to more stringent environmental restrictions, scope changes, political changes, escalation exceeding OMB projections, greater potential for extreme commodity availability and inflation.

Moderate schedule risks, when combined, can also become a time and resulting cost impact. The greater moderate risks include:

- Construction Windows for Endangered Species
- Potential Unknown HTRW Sites
- Potential Cultural Discoveries
- Project Competing with Other Priorities (Staffing)
- Potential Future Construction Claims and Modifications

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

The US Army Corps of Engineers (USACE), Sacramento District presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Sutter Basin Feasibility Study for two Alternatives (SB7 and SB8).

2.0 BACKGROUND

The Sutter Basin Study consists of levee remediation necessary to reduce flood risk to the Sutter Basin. The vast majority of levee remediation consists of seepage prevention by constructing a soil-bentonite slurry cutoff wall through the centerline of the levee and rebuild the levee to pre-project geometry. At some locations, seepage berm, relief wells, deep-soil-mixing, jet grout cutoff wall, canal relocation, and slight levee relocation to provide O&M access roads are included but they are minor relative to the soil-bentonite cutoff wall construction.

The Sutter Basin Feasibility Study considers three (3) Alternatives; Do Nothing; SB7, a Fix-in-Place alternative running for the Feather River West Levee from Sunset Weir to Laurel Avenue; and SB8, a Fix-in-Place alternative for the Feather River West Levee running from Thermalito Afterbay to Laurel Avenue (essentially SB7 plus the additional length from Thermalito Afterbay to Sunset Weir).

The primary project sponsors are the Sutter Butte Flood Control Agency (SBFCA). and the California Department of Water Resources (DWR). The work will likely be complete in 5-7 phases due to funding increment limitations. It is likely that the contracts will be acquired using a RFP procurement. The current construction schedule is approximately 24 months in duration. Construction of the first phase (Star Bend) has been started by the Sponsor with additional phases to begin construction in late FY 3013.

As a part of study effort, Sacramento District has requested that the USACE Cost Engineering Mandatory Center of Expertise for Civil Works (Cost Engineering MCX) provide a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to identify cost and schedule risks with a resulting recommendation for contingencies at the 80 percent confidence level. This report is intended to serve as part of the risk management plan. The CSRA applies the principles mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation

(ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the base case Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Sacramento District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.
- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.
- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Per regulation and guidance, the P80 confidence level (80% confidence level) is the normal and accepted cost confidence level. District Management has the prerogative to select different confidence levels, pending approval from Headquarters, USACE.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a

commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

The Walla Walla Cost Engineering MCX performed the Cost and Schedule Risk Analysis, relying on local Sacramento District staff to provide information gathering. The Walla Walla Cost Engineering MCX facilitated an on-site risk identification meeting on January 24, 2013 with the Sacramento District PDT to produce a risk register that served as the framework for the risk analysis. Participants in risk identification meeting included the following:

Name	Organization	Title
Peter Blodgett	USACE - SPK	Hydraulic Engineer
William Bolte	USACE - NWW	Cost Engineer (Risk Facilitator)
Jane Bolton	USACE - SPK	Geotechnical Engineer
Matt Davis	USACE - SPK	Environmental Engineer
Tri Duong	USACE - SPK	Cost Engineer
Mark Ellis	USACE - SPK	Project Manager
Miki Fujitsubo	USACE - SPK	Planner
Erik Gomez	USACE - SPK	Economist
S. Joe Griffin	USACE - SPK	Cultural Resources
Richard Kristof	USACE - SPK	Civil Engineer
Tung Le	USACE - SPK	Structural Engineer
Michael Musto	DWR	Sponsor Representative
Laurie Parker	USACE – SPK	Real Estate
David Peterson	PBI	Sponsor Representative

Representatives from Construction and Contracting were contacted after the on-site risk identification meeting and given the initial Risk Registry for their review. Their subsequent input has been incorporated into the final Risk Registry.

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in Appendix A for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT.

Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Sutter Basin project.

- a. The Sacramento District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files and a summary Excel spreadsheet detailing all project costs by contract and serves as the basis for the final cost and schedule risk analyses.
- b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.
- c. The CSRA excludes
 - The 01-Lands and Damages and the 06-Fish and Wildlife contingencies were established outside of the risk model.
 - The 30-Preconstruction, Engineering and Design and the 31-Construction Management carry the same % of contingency value as construction; the theory being is that as constructions cost are impacted, so are these two respective accounts.
- d. Schedules are analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay.

Specific to the Sutter Basin project, the schedule was analyzed only for impacts due to residual fixed costs.

e. The risk analyses accounted for escalation over and above the projected Office of Management and Budget (OMB). Based on a detailed calculations for the Isabella Lake Project, Sacramento District has calculated California is 1.92% higher than the OMB rates.

f. Per the data in the estimate, the Overhead percentage for the Prime Contractor is 10%, and 10% for the Subcontractors. Thus, the assumed residual fixed cost rate for this project is 10%. For the P80 schedule, this comprises approximately 22% of the total contingency and 8% of the base cost estimate (9.2% for SB7 and 7.7% for SB8). This is due to the accrual of residual fixed costs associated with delay associated with the implementation schedule.

g. The Cost MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

h. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk “watch list”.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined,

especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P95 confidence levels are also provided for illustrative purposes only.

Table 1A. Construction Cost Contingency Summary – SB7

Risk Analysis Forecast	Total Construction Cost	Total Contingency¹ (\$)	Total Contingency (%)
50% Confidence Level			
Construction Cost	\$250,411,817	\$56,363,817	29.05%
80% Confidence Level			
Construction Cost	\$264,581,025	\$70,533,025	36.35%
95% Confidence Level			
Construction Cost	\$277,706,086	\$83,658,086	43.11%

Notes:

1) These figures combine uncertainty in the baseline cost estimates and schedule.

Table 1B. Construction Cost Contingency Summary – SB8

Risk Analysis Forecast	Total Construction Cost	Total Contingency¹ (\$)	Total Contingency (%)
50% Confidence Level			
Construction Cost	\$464,623,958	\$100,985,958	27.77%
80% Confidence Level			
Construction Cost	\$490,028,500	\$126,390,500	34.76%
95% Confidence Level			
Construction Cost	\$513,495,593	\$149,857,593	41.21%

Notes:

1) These figures combine uncertainty in the baseline cost estimates and schedule.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

Figure 1A. Cost Sensitivity Analysis – SB7

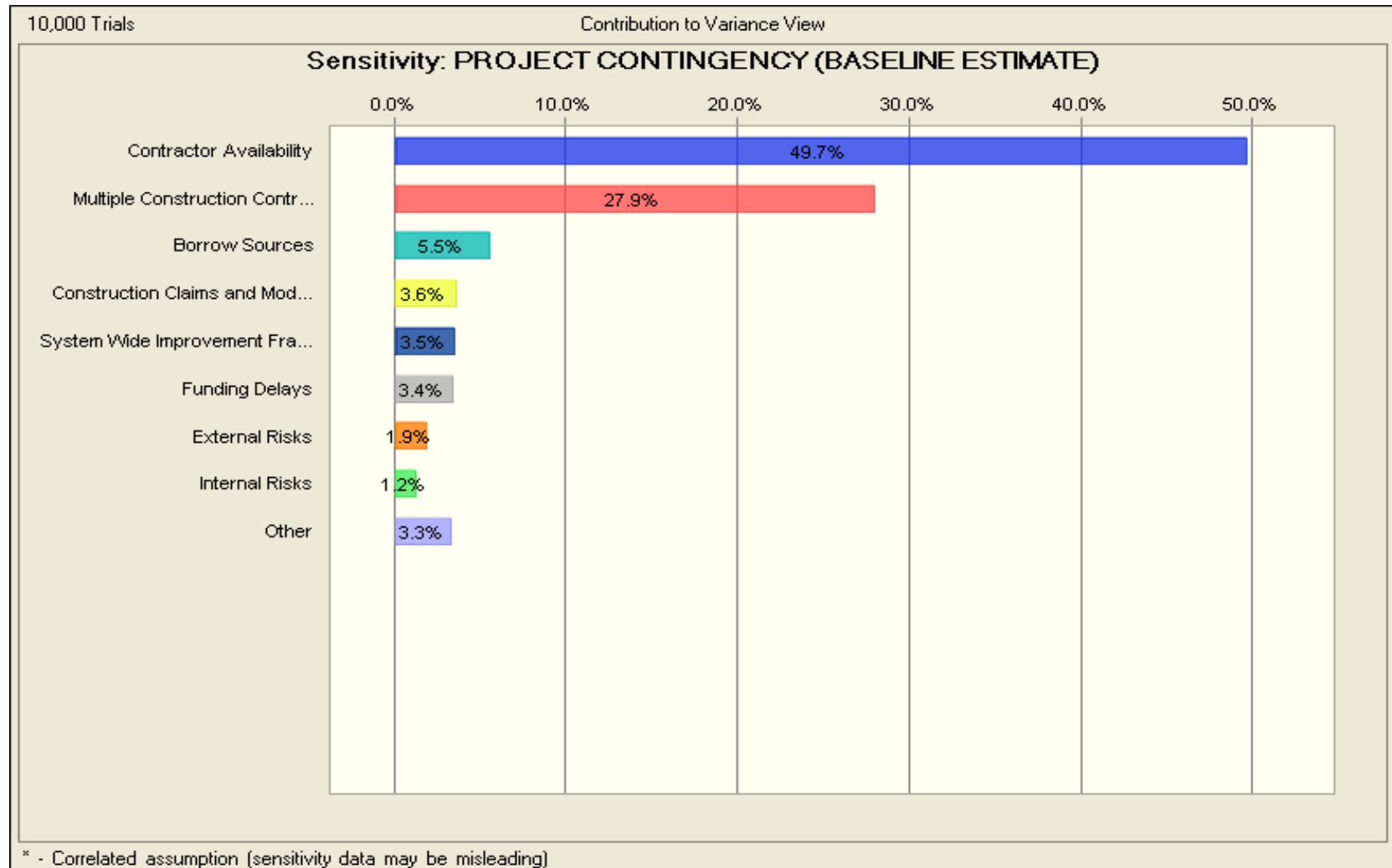
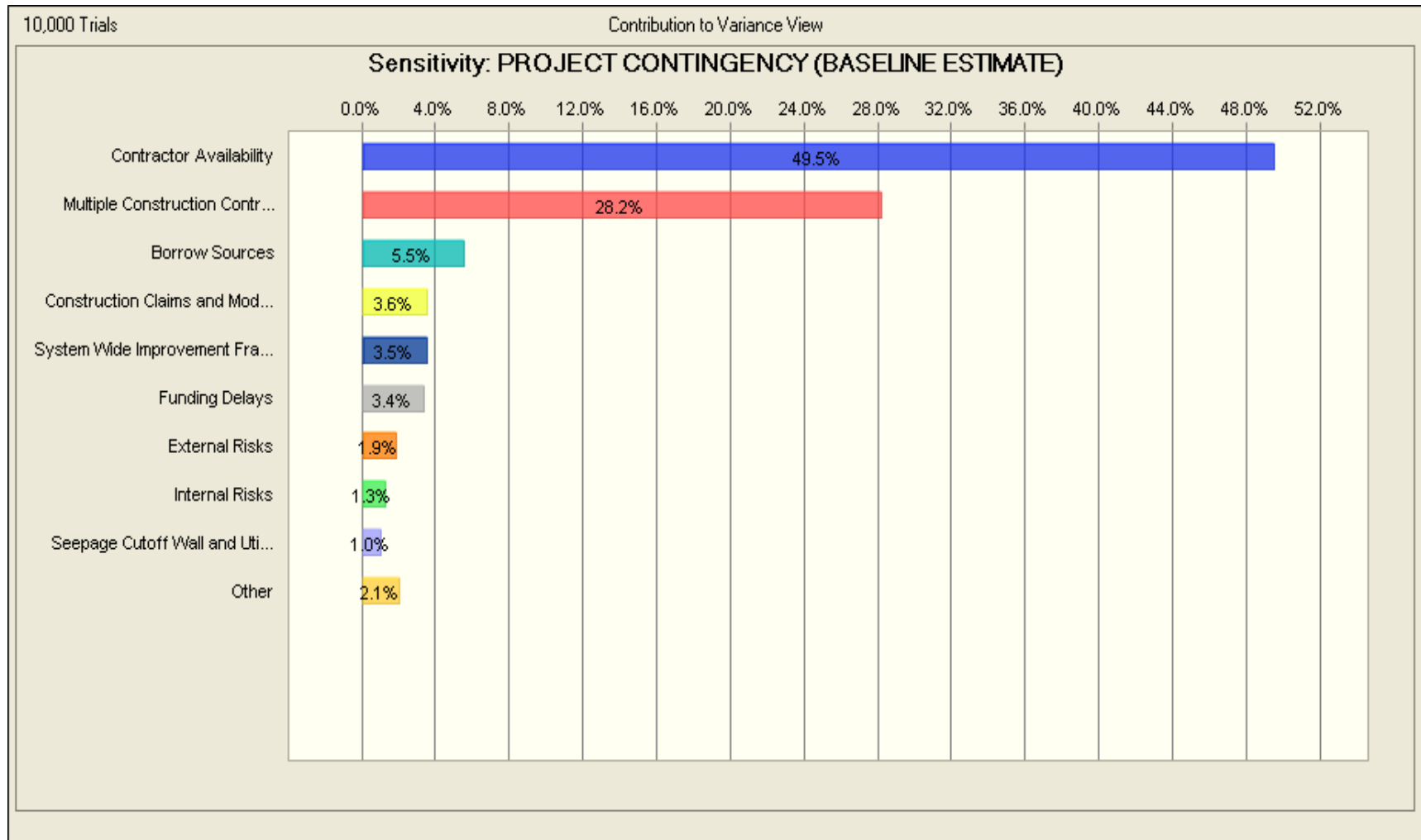


Figure 1B. Cost Sensitivity Analysis – SB8



6.3 Schedule Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P95 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 37 months for SB7 and 41 months for SB8 based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2A. Schedule Duration Contingency Summary – SB7

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency¹ (months)
50% Confidence Level		
Project Duration	60	28
80% Confidence Level		
Project Duration	60	37
95% Confidence Level		
Project Duration	60	45

Notes:

1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.

Table 2A. Schedule Duration Contingency Summary – SB8

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency¹ (months)
50% Confidence Level		
Project Duration	84	31
80% Confidence Level		
Project Duration	84	41
95% Confidence Level		
Project Duration	84	50

Notes:

1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.

Figure 2A. Schedule Sensitivity Analysis – SB7

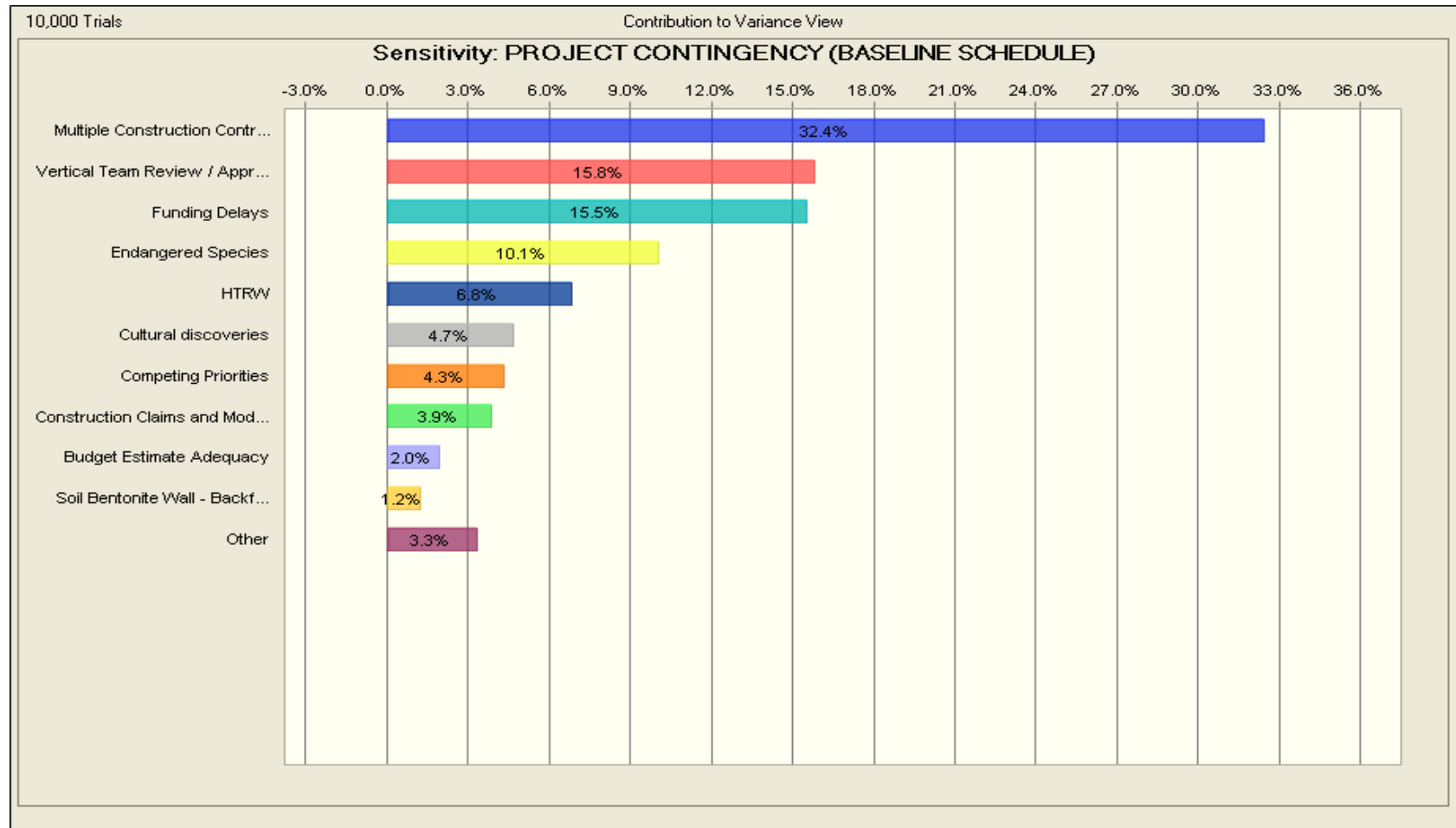
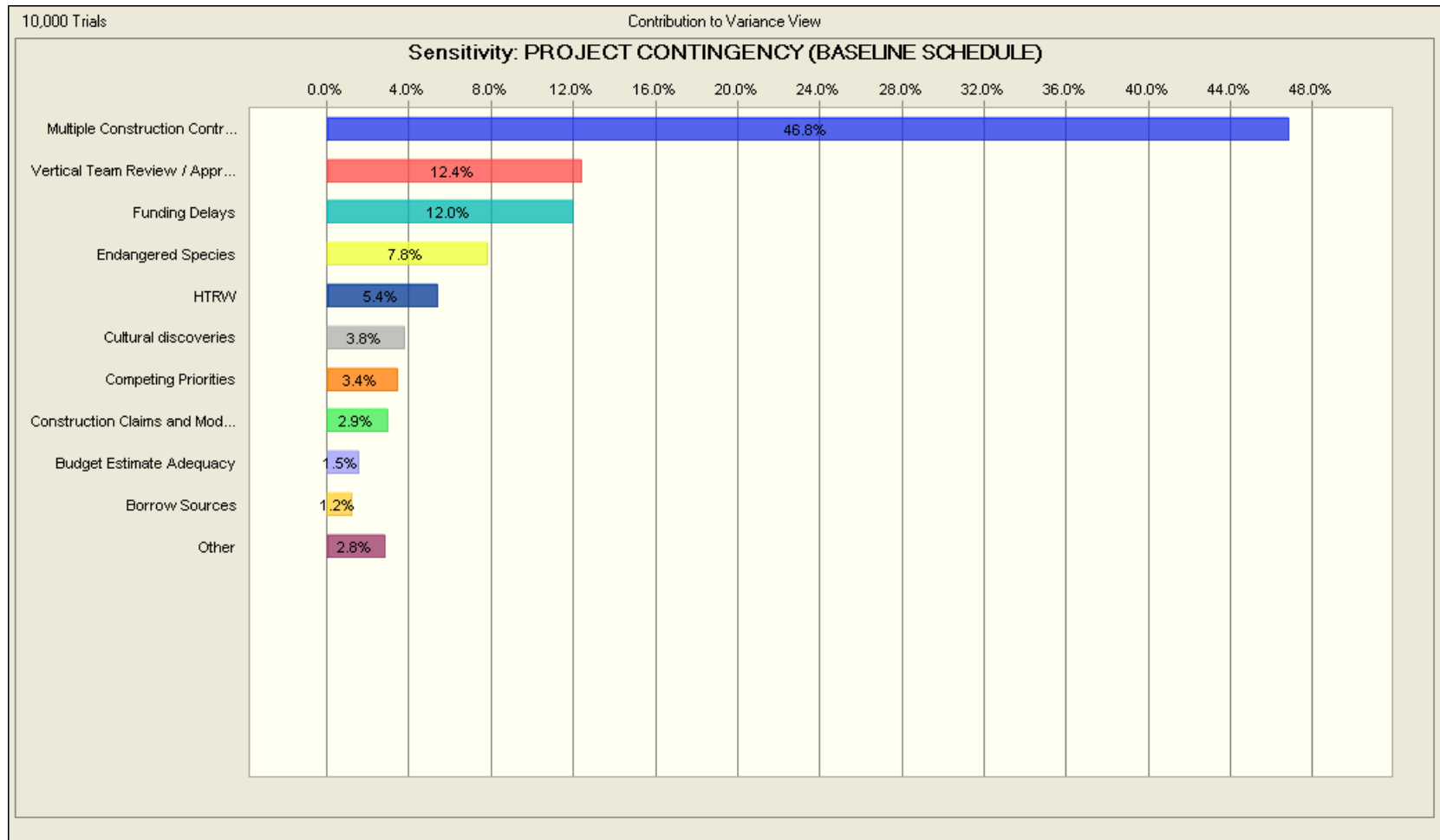


Figure 2B. Schedule Sensitivity Analysis – SB8



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 3 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The key cost risk drivers identified through sensitivity analysis for both Alternatives SB7 and SB8 are CA-3 (Availability of Qualified Contractors) and CA-1 (Multiple Construction Contracts), which together contribute 75 percent of the statistical cost variance.
2. The key schedule risk drivers identified through sensitivity analysis for both Alternatives SB7 and SB8 are CA-1 (Multiple Construction Contracts), PPM-2 (Vertical Team Review and Approval) and FL-1 (Funding Delays), which together contribute some 70 percent of the statistical schedule variance.
3. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full life cycle risk analysis could not be performed. Risk analysis results or conclusions could be significantly different if the necessary operation and maintenance activities were included.

Table 3A. SB7 - Construction Cost Comparison Summary (Uncertainty Analysis)

Confidence Level	Project Cost (\$)	Contingency (\$)	Contingency (%)
0%	\$209,800,350	\$15,752,350	8.12%
5%	\$227,543,693	\$33,495,693	17.26%
10%	\$231,972,265	\$37,924,265	19.54%
15%	\$235,247,242	\$41,199,242	21.23%
20%	\$237,696,139	\$43,648,139	22.49%
25%	\$240,020,408	\$45,972,408	23.69%
30%	\$242,188,027	\$48,140,027	24.81%
35%	\$244,349,283	\$50,301,283	25.92%
40%	\$246,369,322	\$52,321,322	26.96%
45%	\$248,421,570	\$54,373,570	28.02%
50%	\$250,411,817	\$56,363,817	29.05%
55%	\$252,541,259	\$58,493,259	30.14%
60%	\$254,643,854	\$60,595,854	31.23%
65%	\$256,823,021	\$62,775,021	32.35%
70%	\$259,168,844	\$65,120,844	33.56%
75%	\$261,716,448	\$67,668,448	34.87%
80%	\$264,581,025	\$70,533,025	36.35%
85%	\$267,992,159	\$73,944,159	38.11%
90%	\$271,948,428	\$77,900,428	40.14%
95%	\$277,706,086	\$83,658,086	43.11%
100%	\$307,215,136	\$113,167,136	58.32%

Table 3B. SB8 - Construction Cost Comparison Summary (Uncertainty Analysis)

Confidence Level	Project Cost (\$)	Contingency (\$)	Contingency (%)
0%	\$391,772,116	\$28,134,116	7.74%
5%	\$422,824,930	\$59,186,930	16.28%
10%	\$431,001,798	\$67,363,798	18.52%
15%	\$436,624,564	\$72,986,564	20.07%
20%	\$441,020,979	\$77,382,979	21.28%
25%	\$445,349,931	\$81,711,931	22.47%
30%	\$449,430,772	\$85,792,772	23.59%
35%	\$453,213,236	\$89,575,236	24.63%
40%	\$456,886,402	\$93,248,402	25.64%
45%	\$460,663,258	\$97,025,258	26.68%
50%	\$464,623,958	\$100,985,958	27.77%
55%	\$468,139,081	\$104,501,081	28.74%
60%	\$472,170,410	\$108,532,410	29.85%
65%	\$475,882,381	\$112,244,381	30.87%
70%	\$480,241,481	\$116,603,481	32.07%
75%	\$484,956,781	\$121,318,781	33.36%
80%	\$490,028,500	\$126,390,500	34.76%
85%	\$496,174,529	\$132,536,529	36.45%
90%	\$503,436,210	\$139,798,210	38.44%
95%	\$513,495,593	\$149,857,593	41.21%
100%	\$565,245,374	\$201,607,374	55.44%

7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, 4th edition, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis for both Alternatives SB7 and SB8 are CA-3 (Availability of Qualified Contractors) and CA-1 (Multiple Construction Contracts), which together contribute some 75 percent of the statistical cost variance.

- a) Availability of Qualified Contractors: There is inherent risk that the ultimate bidding climate at the time of award of future contracts will be unfavorable to the price, as compared to the current working estimates of contract price. The PDT should continue to perform market research and analysis of trends within the construction industry. Ultimately, this uncertainty cannot be mitigated until more information is available. This should be communicated to management, and an adequate amount of contingency should be reserved to capture this risk.
- b) Multiple Construction Contracts (Funding Constraints): Project leadership should take proactive measures to obtain decisions regarding funding and acquisition strategy, as well as communication to management regarding the impact of those decisions on cost performance.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis for both Alternatives SB7 and SB8 are CA-1 (Multiple Construction Contracts), PPM-2 (Vertical Team Review and Approval) and FL-1 (Funding Delays), which together contribute some 70 percent of the statistical schedule variance.

- a) Multiple Construction Contracts (Funding): Project leadership should take proactive measures to obtain decisions regarding funding and acquisition strategy, as well as communication to management regarding the impact of those decisions on schedule performance.
- b) Vertical Team Review and Approval: Project leadership should proactively coordinate and communicate with Management (both at the District, Division and Headquarters). Ultimately, an amount and duration for this issue should be included and protected within the contingency and/or management reserve.

- c) Funding Delays: Project leadership should proactively coordinate and communicate with Management (both at the District, Division and Headquarters) keeping all parties aware of probable funding and any subsequent impacts.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

Sutter Basin - SB7

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)									
PROJECT & PROGRAM MGMT									
PPM-1	Project competing with other priorities	PDT Design Resources. District has assigned key personnel to various projects. Sutter Pilot study is one of two pilot studies in the nation, so has become a higher priority project. Project Feasibility Study is only funded through FY 13. The schedule currently reflects a Sept 30 Chiefs Report.	With time "priority" status has diminished. Competition for resources will remain an issue through completion of feasibility study. At this point, September 30 competition is likely but review process and unforeseen issues remain possible. A delay into next FY could significantly impact schedule due to unknown availability of future feasibility study funding after September 30.	Very Unlikely	Negligible	LOW	Unlikely	Critical	MODERATE
PPM-2	Vertical Team Review / Approval Process	Vertical Team review and approval (outside of District control) is required to meet critical milestones.	High demands on vertical teams have created a backlog of projects and pilot projects have lost much of their "priority" status.	Very Unlikely	Negligible	LOW	Likely	Critical	HIGH
PPM-3	PED Phase Staffing / Funding	Majority of design is being performed as in-kind work by the sponsor. Non-Federal Sponsor funding is in place and has not been an issue; minimal risks design will be delayed for funding or staffing issues.	Because the sponsor is funding much of the design as in-kind work, funding delays are not a concern.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
PPM-4	Scope Changes	Given the inherent nature of Feasibility Studies, changes in the project scope can be anticipated.	The local sponsor's A/E is actively developing designs and is currently approaching the 90% level. The PDT has used the A/E's 65% plans in development of the NED and LPP plans and feels they are much better prepared than typical feasibility level designs.	Very Unlikely	Marginal	LOW	Very Unlikely	Marginal	LOW
CONTRACT ACQUISITION RISKS									
CA-1	Multiple Construction Contracts	SB-8 Construction Contracts currently divided into 5 contracts with most ~\$50-\$60 Million. Contracts may need to be divided into smaller increments resulting in increased construction costs, government oversight and construction schedules.	Sponsor will proceed ahead with 221 Crediting agreement, working ahead of Federal Funding.	Likely	Significant	HIGH	Likely	Significant	HIGH
CA-2	Incremental Construction Schedule	Fixing the highest risk areas with long delays between projects (5 years or more) could result in last contracts not being completed due to B/C ratios no longer being beneficial.	Projects going beyond 5 years and subject to economic re-evaluation can become problematic.	Very Unlikely	Significant	LOW	Very Unlikely	Negligible	LOW
CA-3	Availability of qualified contractors.	Number of seepage cutoff wall contractors could be limited slowing either schedule (insufficient equipment) or increasing cost (limited competition).	It is the opinion of the PDT that equipment will be available, but limited qualified contractors could lead to moderately higher costs.	Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
TECHNICAL RISKS									
TL-1	Borrow Sources	It has been difficult to find willing landowners to acquire impermeable (clay) borrow material. Cost estimate assumes borrow sources are available and within 25-50miles round trip. Haul could be as much as 100 miles round trip or more. Sponsor may also require additional lengths of time finding "willing" borrow sites.	Real Estate estimate has included a relatively high contingency for procurement of borrow sites.	Likely	Significant	HIGH	Likely	Marginal	MODERATE
TL-2	Changes in Geomorphology	Riprap protection for scour issues has not been included in the current design.	It is assumed that any future scour issues, when they occur, will be covered with O&M funding and outside the scope of this project.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-3	Utility Crossings	Pipe penetrations will be removed and replaced but not necessarily to USACE current design guidance. For example, some large pump stations will not be remodeled to up-and-over type pipe penetrations.	Current project design is sufficient. Given the impracticality of meeting all criteria, design waivers will be acquired and USACE criteria will not dictate future design modifications.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-4	Utility Relocations	Time requirement for coordination of relocation of utility poles could be extensive.	Sponsor is confident relocations will not impact construction award schedules.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-5	O&M Access Road	Current design assumes a 10ft to 20ft land acquisition along the entire length of the toe of the levee for an O&M access road and vegetation free zone.	Real Estate estimate assumes a worst case cost (max land acquisition) but enough uncertainties remain that no potential cost savings will be included.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-6	Utility Corridor	Several areas will require relocation of existing utilities outside the flood critical areas.	Real Estate contingency accounts for additional reaches requiring utility corridor easements.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-7	Soil Bentonite Seepage Cutoff Wall	Design assumes Soil Bentonite Cutoff wall with jet grouting at bridge and railroad crossings. This design is robust enough that any changes in design methodology will not result in cost or schedule increases.	Cost estimate assumes long stick excavation for depths up to 75' design depth and Deep Soil mixing for deeper cutoff walls.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
LANDS AND DAMAGES RISKS									
LD-1	Real Estate - Utility Corridors	Majority of work is on existing levee already owned by the sponsor. Real Estate has assumed 10 ft to 20 ft permanent real estate acquisition (riverside and landside) for O&M access road and vegetation free zone. Real Estate estimate does not include baseline costs for utility relocation corridors.	Real Estate contingency accounts for additional reaches requiring utility corridor easements. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
LD-2	Real Estate - Irrigation Canal and Levee Relocations	Real Estate estimate does not include baseline costs for irrigation canal relocation corridors.	Real Estate contingency accounts for additional relocations. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
LD-3	Real Estate - Structural Relocations	Real Estate estimate does not include demolition costs for potential structural relocations.	There is a placeholder cost of \$1,920,460 in the appraisal. When buildings are impacted it is not unusual for agencies to acquire the entire property (land/building) and make necessary changes---altering or raising the buildings and than resale the remainder. This helps to alleviate the time and cost associated with litigation or working with property owners. It is less costly to acquire the entire property when improvements will be impacted versus trying to modify the existing improvements and compensating property owners for damages. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
LD-4	Real Estate - Temporary Construction Easements	Temporary construction easements have been assumed along the length of the levee construction.	Staging areas have been identified already in the project area. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW

Risk	Risk/Opportunity Event	Concerns		Project Cost	Project Schedule
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No.			PDT Discussions & Conclusions	Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
REGULATORY AND ENVIRONMENTAL RISKS									
RE-1	Air quality	Contractor will require newer equipment to meet air quality requirement, but air quality credits aren't anticipated.	Anticipate qualified California contractor will have worked previous projects with appropriate equipment.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
RE-2	Known cultural Sites	Estimate includes 1% for cultural impacts.	Historical structures downtown will require vibration monitoring.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
RE-3	Cultural discoveries	Cost Estimate includes 1% for cultural investigations.	<p>Majority of work will occur in existing levees, but it is still possible cultural discoveries could be made during construction. Cultural reconnaissance will occur prior to construction and limit possibility of discovery during construction. If cultural discoveries are made, construction must stop in that area. Cultural discovery must be resolved before construction can resume in that reach. IF discovery is made anticipate 3 to 6 month impact.</p> <p>Some 3 miles of Levee and Canal Realignment are required through new previously untouched regions; but greater cultural reconnaissance will be conducted in these areas minimizing potential schedule impacts.</p>	Unlikely	Significant	MODERATE	Likely	Marginal	MODERATE
RE-4	Endangered Species	Construction windows are constrained by Federal and State endangered species windows. Work is currently scheduled outside most species windows but Swainson's Hawk will nest in early spring and fledge in early September.	There is the possibility work could be halted around any nesting areas. Bird surveys may be conducted the prior year to determine risk. (Construction schedule for Irrigation canal Jan-March and Levee April - October).	Very Unlikely	Negligible	LOW	Likely	Marginal	MODERATE
RE-5	Historic Structures	There are a number of historical structures that may or may not need to be relocated, specifically in Yuba City.	Cultural inventories will identify historic structures and assess possible adverse effects. If a historic structure is identified for relocation mitigation for that resources would be governed by a Memorandum of Agreement coordinated with SHPO.	Likely	Negligible	LOW	Very Unlikely	Negligible	LOW
RE-6	HTRW	There may be HTRW sites that are unknown	It is unlikely that HTRW waste be encounter. If HTRW waste is encountered in would not affect cost but the schedule may be affected.	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
CONSTRUCTION RISKS									
CON-1	Seepage Cutoff Wall and Utility Penetrations	Replacement construction of Utility Penetration can't begin until after seepage cutoff wall construction has been completed possibly resulting in long periods of temporary service. Costs have been included for temporary up-and-over services for a limited number of sites (4months each site) .	SB7 Levee has fewer gravity flow utilities (more up-and-over type levee crossings) so likely a marginal cost impact.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
CON-2	Availability of Bentonite	There is risk of escalation on bentonite, pea gravel and course sand. There may be come shortages that could impact the costs and schedule.	In the past, contractor for Mayhew Levee raise encountered difficulties procuring sufficient supplies of bentonite. Bentonite has many applications, including in oil drilling. If multiple other projects also requiring bentonite are under construction concurrently, this could be an issue. Pea gravel and course sand have also presented acquisition issue in the past as well.	Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW
CON-3	Cobbles	Cobbles in the area can slow or even prevent the construction of seepage cutoff walls.	Seepage berms have been included in the design and cost estimate to account for these problematic areas but could anticipate greater numbers required with only a minimal cost/schedule impacts.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
CON-4	Slurry Blowout During Construction	In the event of slurry blowout, would require greater levee degradation, suspension of work during cleanup and additional backfill required.	Worst case assume one blowout every 5 miles at a cost of \$500,000 per blowout. The levee is far enough from the river that seepage into the river and potential environmental impacts is not anticipated.	Likely	Significant	HIGH	Very Unlikely	Negligible	LOW
CON-5	Vagrancy and Loitering Issues	There is the issue of vandalism and damage to the contractor, and there may be some risk transference to the contractor.	The likelihood of claims initiated by the contractor is negligible.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
CON-6	Soil Bentonite Wall - Backfill Material	Consistence of backfill material gradations, specification are reasonable per the drill logs and existing conditions at each site	Historically these types of SB wall contracts include a provision that the KTR use on-site material with a mix of import to meet the backfill requirements. This mixing and subsequent testing of the mix are performed on-site with laboratory results to follow in 3 days. By the time laboratory results are provided backfill has been placed and it becomes a battle on if we remove and replace or give the KTR consideration.	Very Likely	Significant	HIGH	Likely	Marginal	MODERATE
CON-MOD	Modifications and Claims	There is inherent risk of construction modifications and claims that arise after contract award due to issues such as weather, schedules dictated by O&M cycles, differing site conditions, user directed changes or omissions, inaccurate surveys, and variations in estimated quantities (minor).	Post-award construction contract modifications and claims could impact the ultimate contract costs and delay the overall schedule.	Likely	Significant	HIGH	Likely	Significant	HIGH

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
ESTIMATE AND SCHEDULE RISKS									
EST-1	Railroad Crossing	Railroad crossing is currently below crest of levee.	Estimate includes cost of stop log closure structure. May not include costs for establishing temporary railroad services or outages.	Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW
EST-2	Budget Estimate Adequacy	All feature codes are currently captured in the estimate. However, there may be some uncertainty in the disposition of some feature codes.	Crews, assemblies, productivities, and methodologies in the current PCE may not adequately capture ultimate actual contractor technique and costs.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
ECONOMICS RISKS									
FL-1	Funding Delays	With extended funding lags could be multiple years before funding arrives. Protracted construction places the project at greater risks related to more stringent environmental restrictions, scope changes, political changes, escalation exceeding OMB projections, greater potential for extreme commodity availability	Much of this issue exists outside of the scope of the PDT's control, but it is anticipated there will likely be schedule delays and cost increases due to funding lags.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
INT-1	Internal Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to unknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
Programmatic Risks		(External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)							
PR-1	System Wide Improvement Framework (SWIF)	Agreement on ETL vegetation requirements will require negotiation and agreement between three parties (USACE, State of California, and Levee Sponsor) in addition to third party entities.	Cost estimate does not include cost for additional vegetation removal. It may be possible it will be decided this removal will be a project cost (as opposed to O&M).	Likely	Critical	HIGH	Very Unlikely	Negligible	LOW
PR-2	Central Valley Flood Protection Plan	A statewide systemwide program that includes the Sacramento Flood Control Project (study project levees).	Affects all Central Valley studies. Future efforts or alternatives of current studies coordinated as "no regrets actions."	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW
EXT-1	External Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to unknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE

Sutter Basin - SB8

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)									
PROJECT & PROGRAM MGMT									
PPM-1	Project competing with other priorities	PDT Design Resources. District has assigned key personnel to various projects. Sutter Pilot study is one of two pilot studies in the nation, so has become a higher priority project. Project Feasibility Study is only funded through FY 13. The schedule currently reflects a Sept 30 Chiefs Report.	With time "priority" status has diminished. Competition for resources will remain an issue through completion of feasibility study. At this point, September 30 competition is likely but review process and unforeseen issues remain possible. A delay into next FY could significantly impact schedule due to unknown availability of future feasibility study funding after September 30.	Very Unlikely	Negligible	LOW	Unlikely	Critical	MODERATE
PPM-2	Vertical Team Review / Approval Process	Vertical Team review and approval (outside of District control) is required to meet critical milestones.	High demands on vertical teams have created a backlog of projects and pilot projects have lost much of their "priority" status.	Very Unlikely	Negligible	LOW	Likely	Critical	HIGH
PPM-3	PED Phase Staffing / Funding	Majority of design is being performed as in-kind work by the sponsor. Non-Federal Sponsor funding is in place and has not been an issue; minimal risks design will be delayed for funding or staffing issues.	Because the sponsor is funding much of the design as in-kind work, funding delays are not a concern.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
PPM-4	Scope Changes	Given the inherent nature of Feasibility Studies, changes in the project scope can be anticipated.	The local sponsor's A/E is actively developing designs and is currently approaching the 90% level. The PDT has used the A/E's 65% plans in development of the NED and LPP plans and feels they are much better prepared than typical feasibility level designs.	Very Unlikely	Marginal	LOW	Very Unlikely	Marginal	LOW
CONTRACT ACQUISITION RISKS									
CA-1	Multiple Construction Contracts	SB-8 Construction Contracts currently divided into 7 contracts with most ~\$50-\$60 Million. Contracts may need to be divided into smaller increments resulting in increased construction costs, government oversight and construction schedules.	Sponsor will proceed ahead with 221 Crediting agreement, working ahead of Federal Funding.	Likely	Significant	HIGH	Likely	Significant	HIGH
CA-2	Incremental Construction Schedule	Fixing the highest risk areas with long delays between projects (5 years or more) could result in last contracts not being completed due to B/C ratios no longer being beneficial.	Projects going beyond 5 years and subject to economic re-evaluation can become problematic.	Very Unlikely	Significant	LOW	Very Unlikely	Negligible	LOW
CA-3	Availability of qualified contractors.	Number of seepage cutoff wall contractors could be limited slowing either schedule (insufficient equipment) or increasing cost (limited competition).	It is the opinion of the PDT that equipment will be available, but limited qualified contractors could lead to moderately higher costs.	Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
TECHNICAL RISKS									
TL-1	Borrow Sources	It has been difficult to find willing landowners to acquire impermeable (clay) borrow material. Cost estimate assumes borrow sources are available and within 25-50miles round trip. Haul could be as much as 100 miles round trip or more. Sponsor may also require additional lengths of time finding "willing" borrow sites.	Real Estate estimate has included a relatively high contingency for procurement of borrow sites.	Likely	Significant	HIGH	Likely	Marginal	MODERATE
TL-2	Changes in Geomorphology	Riprap protection for scour issues has not been included in the current design.	It is assumed that any future scour issues, when they occur, will be covered with O&M funding and outside the scope of this project.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-3	Utility Crossings	Pipe penetrations will be removed and replaced but not necessarily to USACE current design guidance. For example, some large pump stations will not be remodeled to up-and-over type pipe penetrations.	Current project design is sufficient. Given the impracticality of meeting all criteria, design waivers will be acquired and USACE criteria will not dictate future design modifications.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-4	Utility Relocations	Time requirement for coordination of relocation of utility poles could be extensive.	Sponsor is confident relocations will not impact construction award schedules.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-5	O&M Access Road	Current design assumes a 10ft to 20ft land acquisition along the entire length of the toe of the levee for an O&M access road and vegetation free zone.	Real Estate estimate assumes a worst case cost (max land acquisition) but enough uncertainties remain that no potential cost savings will be included.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-6	Utility Corridor	Several areas will require relocation of existing utilities outside the flood critical areas.	Real Estate contingency accounts for additional reaches requiring utility corridor easements.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-7	Soil Bentonite Seepage Cutoff Wall	Design assumes Soil Bentonite Cutoff wall with jet grouting at bridge and railroad crossings. This design is robust enough that any changes in design methodology will not result in cost or schedule increases.	Cost estimate assumes long stick excavation for depths up to 75' design depth and Deep Soil mixing for deeper cutoff walls.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
TL-8	Abandoned Drainage penetrations	Cost included for removal of abandoned penetrations. Additional engineering effort will be required to justify no internal drainage issues will be caused.	Additional effort will have minimal impacts to design cost and schedule.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
LANDS AND DAMAGES RISKS									
LD-1	Real Estate - Utility Corridors	Majority of work is on existing levee already owned by the sponsor. Real Estate has assumed 10 ft to 20 ft permanent real estate acquisition (riverside and landside) for O&M access road and vegetation free zone. Real Estate estimate does not include baseline costs for utility relocation corridors.	Real Estate contingency accounts for additional reaches requiring utility corridor easements. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
LD-2	Real Estate - Irrigation Canal and Levee Relocations	Real Estate estimate does not include baseline costs for irrigation canal relocation corridors.	Real Estate contingency accounts for additional relocations. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
LD-3	Real Estate - Structural Relocations	Real Estate estimate does not include demolition costs for potential structural relocations.	There is a placeholder cost of \$1,920,460 in the appraisal. When buildings are impacted it is not unusual for agencies to acquire the entire property (land/building) and make necessary changes---altering or raising the buildings and than resale the remainder. This helps to alleviate the time and cost associated with litigation or working with property owners. It is less costly to acquire the entire property when improvements will be impacted versus trying to modify the existing improvements and compensating property owners for damages. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
LD-4	Real Estate - Temporary Construction Easements	Temporary construction easements have been assumed along the length of the levee construction.	Staging areas have been identified already in the project area. REAL ESTATE CONTINGENCY HAS BEEN DEVELOPED INDEPENDENTLY AND WILL NOT BE INCLUDED IN THIS EVALUATION.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
REGULATORY AND ENVIRONMENTAL RISKS									
RE-1	Air quality	Contractor will require newer equipment to meet air quality requirement, but air quality credits aren't anticipated.	Anticipate qualified California contractor will have worked previous projects with appropriate equipment.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
RE-2	Known cultural Sites	Estimate includes 1% for cultural impacts.	Historical structures downtown will require vibration monitoring.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
RE-3	Cultural discoveries	Cost Estimate includes 1% for cultural investigations.	Majority of work will occur in existing levees, but it is still possible cultural discoveries could be made during construction. Cultural reconnaissance will occur prior to construction and limit possibility of discovery during construction. If cultural discoveries are made, construction must stop in that area. Cultural discovery must be resolved before construction can resume in that reach. IF discovery is made anticipate 3 to 6 month impact. Some 3 miles of Levee and Canal Realignment are required through new previously untouched regions; but greater cultural reconnaissance will be conducted in these areas minimizing potential schedule impacts.	Unlikely	Significant	MODERATE	Likely	Marginal	MODERATE
RE-4	Endangered Species	Construction windows are constrained by Federal and State endangered species windows. Work is currently scheduled outside most species windows but Swainson's Hawk will nest in early spring and fledge in early September.	There is the possibility work could be halted around any nesting areas. Bird surveys may be conducted the prior year to determine risk. (Construction schedule for Irrigation canal Jan-March and Levee April - October).	Very Unlikely	Negligible	LOW	Likely	Marginal	MODERATE
RE-5	Historic Structures	There are a number of historical structures that may or may not need to be relocated, specifically in Yuba City.	Cultural inventories will identify historic structures and assess possible adverse effects. If a historic structure is identified for relocation mitigation for that resources would be governed by a Memorandum of Agreement coordinated with SHPO.	Likely	Negligible	LOW	Very Unlikely	Negligible	LOW
RE-6	HTRW	There may be HTRW sites that are unknown	It is unlikely that HTRW waste be encounter. If HTRW waste is encountered in would not affect cost but the schedule may be affected.	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
CONSTRUCTION RISKS									
CON-1	Seepage Cutoff Wall and Utility Penetrations	Replacement construction of Utility Penetration can't begin until after seepage cutoff wall construction has been completed possibly resulting in long periods of temporary service. Costs have been included for temporary up-and-over services for a limited number of sites (4months each site) .	SB8 Levee reach has multiple gravity flow lines that could be impacted.	Likely	Significant	HIGH	Likely	Marginal	MODERATE
CON-2	Availability of Bentonite	There is risk of escalation on bentonite, pea gravel and course sand. There may be come shortages that could impact the costs and schedule.	In the past, contractor for Mayhew Levee raise encountered difficulties procuring sufficient supplies of bentonite. Bentonite has many applications, including in oil drilling. If multiple other projects also requiring bentonite are under construction concurrently, this could be an issue. Pea gravel and course sand have also presented acquisition issue in the past as well.	Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW
CON-3	Cobbles	Cobbles in the area can slow or even prevent the construction of seepage cutoff walls. Seepage berms have been included in the design and cost estimate to account for these problematic areas but could anticipate greater numbers required.	Greater likelihood of encountering cobbles in SB8 regions, but larger numbers of seepage berms have also been included so assume minimal impacts.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
CON-4	Slurry Blowout During Construction	In the event of slurry blowout, would require greater levee degradation, suspension of work during cleanup and additional backfill required.	Worst case assume one blowout every 5 miles at a cost of \$500,000 per blowout. The levee is far enough from the river that seepage into the river and potential environmental impacts is not anticipated.	Likely	Significant	HIGH	Very Unlikely	Negligible	LOW
CON-5	Vagrancy and Loitering Issues	There is the issue of vandalism and damage to the contractor, and there may be some risk transference to the contractor.	The likelihood of claims initiated by the contractor is negligible.	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW
CON-6	Soil Bentonite Wall - Backfill Material	Consistence of backfill material gradations, specification are reasonable per the drill logs and existing conditions at each site	Historically these types of SB wall contracts include a provision that the KTR use on-site material with a mix of import to meet the backfill requirements. This mixing and subsequent testing of the mix are performed on-site with laboratory results to follow in 3 days. By the time laboratory results are provided backfill has been placed and it becomes a battle on if we remove and replace or give the KTR consideration.	Very Likely	Significant	HIGH	Likely	Marginal	MODERATE
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Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule		
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
ESTIMATE AND SCHEDULE RISKS									
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EST-2	Budget Estimate Adequacy	All feature codes are currently captured in the estimate. However, there may be some uncertainty in the disposition of some feature codes.	Crews, assemblies, productivities, and methodologies in the current PCE may not adequately capture ultimate actual contractor technique and costs.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
ECONOMICS RISKS									
FL-1	Funding Delays	With extended funding lags could be multiple years before funding arrives. Protracted construction places the project at greater risks related to more stringent environmental restrictions, scope changes, political changes, escalation exceeding OMB projections, greater potential for extreme commodity availability	Much of this issue exists outside of the scope of the PDT's control, but it is anticipated there will likely be schedule delays and cost increases due to funding lags.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
INT-1	Internal Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to unknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
Programmatic Risks		(External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)							
PR-1	System Wide Improvement Framework (SWIF)	Agreement on ETL vegetation requirements will require negotiation and agreement between three parties (USACE, State of California, and Levee Sponsor) in addition to third party entities.	Cost estimate does not include cost for additional vegetation removal. It may be possible it will be decided this removal will be a project cost (as opposed to O&M).	Likely	Critical	HIGH	Very Unlikely	Negligible	LOW
PR-2	Central Valley Flood Protection Plan	A statewide systemwide program that includes the Sacramento Flood Control Project (study project levees).	Affects all Central Valley studies. Future efforts or alternatives of current studies coordinated as "no regrets actions."	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW
EXT-1	External Risk	There is inherent risk in all projects that could contribute to cost and schedule variance due to unknowns.	This could impact cost and schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

Project No. 105638

SPK – Sutter Basin Project

Two Alternatives for the Sutter Basin Project, as presented by Sacramento District, have undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scopes, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of October 10, 2013, the Cost MCX certifies the estimated total project cost of the two alternatives:

ALTERNATIVE SB-7

FY 2014 Price Level: \$391,840,000

Fully Funded Amount: \$440,530,000

ALTERNATIVE SB-8

FY 2014 Price Level: \$688,930,000

Fully Funded Amount: \$791,970,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management throughout the life of the project.

**CALLAN.KIM.C.1231
558221**

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ou=USA, cn=CALLAN.KIM.C.1231558221
Date: 2013.10.11 07:30:26 -07'00'



**US Army Corps
of Engineers®**

**Kim C. Callan, PE, CCE, PM1
Chief, Cost Engineering MCX
Walla Walla District**

*****TOTAL PROJECT COST SUMMARY*****														10/10/2013	
THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE DRAFT FEASIBILITY REPORT, ALT. SB-7															
PROJECT: Sutter Basin TPCS														U. S. ARMY CORPS OF ENGINEER, SACRAMENTO DISTRICT	
LOCATION: CALIFORNIA														P.O.C.: JEREMIAH A. FROST, CHIEF, COST ENGINEERING SECTION	
Current MCACES Estimate Prepared: 25-Jul-2013															
Effective Price Level (EPL): 1-Oct-2013															
WB NO.	Civil Works FEATURE DESCRIPTION	ESTIMATED COST				PROGRAM YEAR(BUDGET EC) 2014 EFF. PRICE LEVEL DATE:1-Oct-2013 PROJECT FIRST COST				TOTAL PROJECT COST (FULLY FUNDED)					
		COST (\$K)	CNTG (\$K)	CNTG (%)	TOTAL (\$K)	ESC. (%)	COST (\$K)	CNTG (\$K)	TOTAL (\$K)	SPENT THRU: 1-Oct-2013 COST ESC. (\$K) MIDPT(%)		COST (\$K)	CNTG (\$K)	FULLY FUNDED (\$K)	
Index Codes: 0 - no esc. applied; A - Administration; C - Combined indexes; All other codes used coincides with the Code of Accounts.															
		Contingency Applied To Remaining Cost Only													
FEDERAL COSTS															
6	FISH & WILDLIFE FACILITIES	5,032	1,006	20	6,038	0.00	5,032	1,006	6,038	0	12	5,611	1,122	6,733	
11	LEVEES & FLOODWALLS	176,205	63,717	36	239,922	0.00	176,205	63,717	239,922	0	11	196,085	70,906	266,991	
18	CULT. RESRC. PRESERV. (1) Data Recovery	1,655	598		2,253		1,655	598	2,253	0		1,841	665	2,506	
		1,200	433		1,633	0.00	1,200	433	1,633	0		1,334	482	1,816	
	Inventory/Evaluation/Mitigation Costs	455	165	36	620	0.00	455	165	620	0	11	507	183	690	
SUBTOTAL FEDERAL & NON-FEDERAL CONSTRUCTION COSTS		182,892	65,321		248,213		182,892	65,321	248,213	0		203,537	72,693	276,230	
1	LANDS & DAMAGES, Admin (2)	6,952	348	5	7,300	0.00	6,952	348	7,300	0	17	8,168	408	8,576	
30	PLAN/ENGINEERING/DESIGN	32,622	11,797	36	44,419	0.00	32,622	11,797	44,419	0	18	38,534	13,934	52,468	
31	CONSTRUCTION MANAGE'MT	15,406	5,570	36	20,976	0.00	15,406	5,570	20,976	0	23	18,943	6,849	25,792	
SUBTOTAL FEDERAL & NON-FEDERAL CONTRIBUTION		237,872	83,036		320,908		237,872	83,036	320,908	0		269,182	93,884	363,066	
NON-FEDERAL CONTRIBUTION (-)		-48,533	-17,105		-65,638		-48,533	-17,105	-65,638	0		-56,289	-19,847	-76,136	
TOTAL FEDERAL COSTS		\$189,339	\$65,931		\$255,270		\$189,339	\$65,931	\$255,270	\$0		\$212,893	\$74,037	\$286,930	
NON-FEDERAL COSTS															
1	LANDS AND DAMAGES	31,811	10,579	33	42,390	0.00	31,811	10,579	42,390	0	8.5	34,523	11,481	46,004	
2	RELOCATIONS Relocations Construction Cost	20,962	7,580		28,542		20,962	7,580	28,542	0		23,105	8,355	31,460	
		16,376	5,922	36	22,298	0.00	16,376	5,922	22,298	0	10	18,074	6,536	24,610	
	Plan/Engineering/Design	2,948	1,066	36	4,014	0.00	2,948	1,066	4,014	0	8.8	3,209	1,160	4,369	
	Construction Mangement	1,638	592	36	2,230	0.00	1,638	592	2,230	0	11	1,822	659	2,481	
SUBTOTAL NON-FEDERAL		52,773	18,159		70,932		52,773	18,159	70,932	0		57,628	19,836	77,464	
NON-FEDERAL CONTRIBUTION (+)		48,533	17,105		65,638		48,533	17,105	65,638	0		56,289	19,847	76,136	
TOTAL NON-FEDERAL COSTS		\$101,306	\$35,264		\$136,570		\$101,306	\$35,264	\$136,570	\$0		\$113,917	\$39,683	\$153,600	
TOTAL FEDERAL AND NON-FEDERAL COSTS		\$290,645	\$101,195		\$391,840		\$290,645	\$101,195	\$391,840	\$0		\$326,810	\$113,720	\$440,530	
GENERAL NOTES															
(1) Cultural Resources Preservation costs was provided by Cultural Resources Archaeologist.															
(2) Federal administrative costs for non-Federal land acquisition.															
(3) The Fully Funded cost estimate was prepared in compliance with Indexes used from CWCCIS reflecting OMB future rates Mar. 31, 2013															
(4) 01 Account for Land and Damages cost are from Real Estates.															
(5) 06 Account Fish and Wildlife Cost was provided by SPK Environmental Planning.															
(6) 30 Account Planning, Engineering and Design and 31 Account Construction Management cost was provided by its respective organizations.															
CONTINGENCY RATIONALE															
(A) CONTINGENCIES USED WAS DERIVED BY THE COST RISK ANALYSIS PROCESS AND IS BASED ON A 80% CONFIDENCE LEVEL															
CHIEF, COST ENGINEERING														TOTAL FEDERAL COSTS	\$286,930
PROJECT MANAGER														TOTAL NON-FEDERAL COSTS	\$153,600
CHIEF, REAL ESTATE														THE MAXIMUM PROJECT COSTS	\$440,530

*****TOTAL PROJECT COST SUMMARY*****															10/10/2013
THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE DRAFT FEASIBILITY REPORT, ALT. SB-8															
PROJECT: Sutter Basin TPCS															
LOCATION: CALIFORNIA															
U. S. ARMY CORPS OF ENGINEER, SACRAMENTO DISTRICT															
P.O.C.: JEREMIAH A. FROST, CHIEF, COST ENGINEERING SECTION															
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			CNTG (\$K)	CNTG (%)	TOTAL (\$K)	ESC. (%)	COST (\$K)	CNTG (\$K)	TOTAL (\$K)	SPENT THRU: 1-Oct-2013		COST (\$K)	CNTG (\$K)	FULLY FUNDED (\$K)	
										COST (\$K)	ESC. MIDPT(%)				
Index Codes: 0 - no esc. applied; A - Administration; C - Combined indexes; All other codes used coincides with the Code of Accounts.															
FEDERAL COSTS		Contingency Applied To Remaining Cost Only													
6	FISH & WILDLIFE FACILITIES	6,330	1,265	20	7,595	0.00	6,330	1,265	7,595	0	14	7,226	1,445	8,671	
11	LEVEES & FLOODWALLS	306,367	106,488	35	412,855	0.00	306,367	106,488	412,855	0	13	347,604	120,821	468,425	
18	CULT. RESRC. PRESERV. (1	3,030	1,076		4,106		3,030	1,076	4,106			3,399	1,207	4,606	
	Federal Obligations from NED Cost.	1,655	598		2,253		1,655	598	2,253			1,841	665	2,506	
	Data Recovery	1,200	433		1,633		1,200	433	1,633	0		1,334	482	1,816	
	Inventory/Evaluation/Mitigation Costs	455	165		620		455	165	620	0		507	183	690	
	Cost Beyond NED Cost.	1,375	478		1,853		1,375	478	1,853	0		1,558	542	2,100	
	Data Recovery	1,000	348	35	1,348	0.00	1,000	348	1,348	0	13	1,134	394	1,528	
	Inventory/Evaluation/Mitigation Costs	375	130	35	505	0.00	375	130	505	0	13	424	148	572	
SUBTOTAL FEDERAL & NON-FEDERAL CONSTRUCTION COSTS		315,727	108,829		424,556		315,727	108,829	424,556	0		358,229	123,473	481,702	
1	LANDS & DAMAGES, Admin (2	11,143	557	5	11,700	0.00	11,143	557	11,700	0	22	13,549	677	14,226	
30	PLAN/ENGINEERING/DESIGN	56,285	19,565	35	75,850	0.00	56,285	19,565	75,850	0	22	68,804	23,916	92,720	
31	CONSTRUCTION MANAGE/MT	26,580	9,239	35	35,819	0.00	26,580	9,239	35,819	0	27	33,791	11,746	45,537	
SUBTOTAL FEDERAL & NON-FEDERAL CONTRIBUTION		409,735	138,190		547,925		409,735	138,190	547,925	0		474,373	159,812	634,185	
NON-FEDERAL CONTRIBUTION(-)		-220,396	-72,259		-292,655		-220,396	-72,259	-292,655	0		-261,480	-85,775	-347,255	
TOTAL FEDERAL NED COSTS		\$189,339	\$65,931		\$255,270		\$189,339	\$65,931	\$255,270	\$0		\$212,893	\$74,037	\$286,930	
NON-FEDERAL COSTS															
1	LANDS AND DAMAGES	41,795	11,751	28	53,546	0.00	41,795	11,751	53,546	0	11	46,222	12,995	59,217	
2	RELOCATIONS	64,900	22,559		87,459		64,900	22,559	87,459	0		73,143	25,425	98,568	
	Relocations Construction Cost	50,703	17,624	35	68,327	0.00	50,703	17,624	68,327	0	13	57,271	19,907	77,178	
	Plan/Engineering/Design	9,127	3,172	35	12,299	0.00	9,127	3,172	12,299	0	11	10,123	3,519	13,642	
	Construction Management	5,070	1,763	35	6,833	0.00	5,070	1,763	6,833	0	13	5,749	1,999	7,748	
SUBTOTAL NON-FEDERAL		106,695	34,310		141,005		106,695	34,310	141,005	0		119,365	38,420	157,785	
NON-FEDERAL CONTRIBUTION (+)		220,396	72,259		292,655		220,396	72,259	292,655	0		261,480	85,775	347,255	
	Non-Federal Contribution - NED	48,533	17,105		65,638		48,533	17,105	65,638	0		56,289	19,847	76,136	
	Additional Cost Above NED	171,863	55,154		227,017		171,863	55,154	227,017	0		205,191	65,928	271,119	
TOTAL NON-FEDERAL COSTS		\$327,091	\$106,569		\$433,660		\$327,091	\$106,569	\$433,660	\$0		\$380,845	\$124,195	\$505,040	
TOTAL FEDERAL AND NON-FEDERAL COSTS		\$516,430	\$172,500		\$688,930		\$516,430	\$172,500	\$688,930	\$0		\$593,738	\$198,232	\$791,970	
GENERAL NOTES															
(1) Cultural Resources Preservation costs was provided by Cultural Resources Archaeologist.															
(2) Federal administrative costs for non-Federal land acquisition.															
(3) The Fully Funded cost estimate was prepared in compliance with Indexes used from CWCCIS reflecting OMB future rates Mar. 31, 2013															
(4) 01 Account for Land and Damages cost are from Real Estates.															
(5) 06 Account Fish and Wildlife Cost was provided by SPK Environmental Planning.															
(6) 30 Account Planning, Engineering and Design and 31 Account Construction Management cost was provided by its respective organizations.															
(A) CONTINGENCIES USED WAS DERIVED BY THE COST RISK ANALYSIS PROCESS AND IS BASED ON A 80% CONFIDENCE LEVEL															
CHIEF, COST ENGINEERING										TOTAL FEDERAL COSTS		DOLLAR(K)			
												\$286,930			
PROJECT MANAGER										TOTAL NON-FEDERAL COSTS		\$505,040			
										THE MAXIMUM PROJECT COSTS		\$791,970			
CHIEF, REAL ESTATE															